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Purdue University

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AN EVALUATION OF THE PRODUCTION CONTROL PROCEDURE

AT THE NAVAL ORDNANCE PLANT INDIANAPOLIS

A Thesis

Submitted to the Faculty

of

Purdue University

by

Gordon E. Hartley

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science in Industrial Engineering

June, 1950

Thesis
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ACKNOWLEDGEMENT

The majority of the principles expounded herein have been the natural result of numerous conferences with people engaged in Production Control today integrated with the concepts of production control as taught in current academic courses. It is indeed proper that this acknowledgement be made to give credit, where appropriate, for the data obtained.

To Captain A. D. Blackledge, Commanding Officer, Naval Ordnance Plant, Indianapolis; to Mr. D. D. Dennis, Head of the Production Control Division; and to the staff of the plant, whose sincere and extremely helpful cooperation greatly aided the investigation, the author wishes to express his deepest gratitude.

Profound appreciation is extended to Professor Halsey F. Owen of the Industrial Engineering Department, Purdue University, for his excellent guidance throughout the study.

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ABSTRACT

This study was undertaken in order that an evaluation could be made of the production control procedure employed by the Naval Ordnance Plant, Indianapolis, Indiana. The criteria upon which the evaluation was based included various basic principles of production control that are expounded by several authors of current production control literature, and which are taught in current academic courses.

The majority of the material upon which the investigation is based was obtained at the Naval Ordnance Plant, Indianapolis, Indiana. Conferences were used as a means of gathering the information necessary from each responsible individual of the Production Control Division. These conferences as well as the observation of the day to day accomplishment of the production control functions resulted in a thorough coverage of the units and their responsibilities in the production control procedure as it is practiced at the plant. The information gathered and the procedures observed were then compared with the criteria of generally accepted production control procedures.

The results of this evaluation are most gratifying. In terms of the criteria used, the Naval Ordnance Plant, Indianapolis, Indiana, has a progressive production control procedure that has been planned and executed by very capable and farsighted individuals who have recognized the potentialities of a flexible procedure of production control. Considering the needs of the plant, it can be concluded that no major modifications to the present system are needed and that only a very few minor techniques could be improved.

This study was conducted in order to see whether there

is any relation between the amount of the total population
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AN EVALUATION OF THE PRODUCTION CONTROL PROCEDURE
AT THE NAVAL ORDNANCE PLANT INDIANAPOLIS

INTRODUCTION

The field of production control has felt the impact of the demands placed on it by a Second World War and the changes wrought by the postwar era of shortages of material, disparity of price rises, difficulty of sales forecast, and other extreme uncertainties. No system or procedure could remain static under the ever-changing demands of the industrial world as portrayed by the examples above. Upheavals in the social, economical, and political aspect of our American way of life also have had their part in molding changes in the concept of production control. This study was undertaken to evaluate the application of the basic principles of production control at the Naval Ordnance Plant, Indianapolis, Indiana, hereinafter referred to as NOPI, and what deviations from or modifications of these basic principles have resulted from the conditions evolving because of the particularly specialized work accomplished by NOPI.

Work done previously which is related to this problem includes a thesis by Lieutenant Colonel Robert W. Breaks, USA, "An Appraisal of the Production Control Methods Used in Government Arsenals," June 1947. This thesis dealt with the production control methods applicable to the problems of chemical manufacture.

The majority of the information upon which this study is based was obtained at NOPI. Conferences with unit personnel in the Production Control Division were used to accumulate sufficient information about the functions of the individual unit to describe in general its respon-

ANALYSIS OF THE ECONOMIC SITUATION IN
THE UNITED STATES

INTRODUCTION

The first of the two main sections of the report is devoted to a general survey of the economic situation in the United States. It is divided into three parts: (1) a general survey of the economic situation in the United States; (2) a survey of the economic situation in the United States; and (3) a survey of the economic situation in the United States. The second section of the report is devoted to a detailed analysis of the economic situation in the United States. It is divided into two parts: (1) a detailed analysis of the economic situation in the United States; and (2) a detailed analysis of the economic situation in the United States.

The third section of the report is devoted to a detailed analysis of the economic situation in the United States. It is divided into two parts: (1) a detailed analysis of the economic situation in the United States; and (2) a detailed analysis of the economic situation in the United States. The fourth section of the report is devoted to a detailed analysis of the economic situation in the United States. It is divided into two parts: (1) a detailed analysis of the economic situation in the United States; and (2) a detailed analysis of the economic situation in the United States.

The fifth section of the report is devoted to a detailed analysis of the economic situation in the United States. It is divided into two parts: (1) a detailed analysis of the economic situation in the United States; and (2) a detailed analysis of the economic situation in the United States. The sixth section of the report is devoted to a detailed analysis of the economic situation in the United States. It is divided into two parts: (1) a detailed analysis of the economic situation in the United States; and (2) a detailed analysis of the economic situation in the United States.

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sibilities and place in the organizational structure of the division. Using this information as a basis for investigation, this study was compiled by considering the functions of production control as practiced at NCFI in comparison to the criteria of generally accepted production control procedures.

The interpretations of the definition of production control as expressed by many authors in current literature have an extremely broad scope. For the purpose of this study, production control will be defined as the mental and physical know-how applied in such a manner that the right quantity and quality of a product will be produced at the right time by the best and cheapest methods. Although there is a wide diversity of opinion in the literature on production control as to the functions which should be included in a production control procedure, the functions listed below are a few of those appearing in the texts of the Bibliography, and they will be considered as a criteria for this study.

1. The preparation and issuing of production orders and forms
2. Purchase requisitioning of raw materials and special items
3. Preparation of route sheets
4. Work scheduling
5. Plant loading
6. Work dispatching
7. Determination of the labor requirements
8. Maintenance of production records
9. Expediting of manufactured and purchased items
10. Analysis of idle machine time

studies and also in the development of the industry.

Under this information for a basis for investigation, this study was the

first by providing the foundation for production control and planning

as well as comparison to the results of previously completed production

control procedures.

The investigation of the utilization of production control

was carried out by means of a survey in which it was found that the industry

based upon the purpose of this study, production control will be

defined as the control and physical knowledge applied to such a system

that the right quantity and quality of a product will be produced at the

right time by the best and cheapest methods. Although there is a close

relationship of opinion in the literature on production control as to the

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THE NAVAL ORDNANCE PLANT, INDIANAPOLIS, INDIANA

The History, Organization, and Physical Properties of the U. S. Naval Ordnance Plant, Indianapolis, Indiana

This plant was designed, constructed, and staffed by a civilian engineering company during World War II for the purpose of manufacturing the Norden bombsight and related equipment, and aircraft lead-computing gunsight systems; some sixty thousand fire control instruments were manufactured during World War II.

Late in 1945, the plant was taken over by the Navy. It is now being run under the cognizance of the Bureau of Ordnance, Navy Department. As a Naval Shore Establishment, the plant has the following functions:

- (1) research in, and engineering development of, aviation fire control equipment;
- (2) the manufacture of that equipment;
- (3) the manufacture of line maintenance stores;
- (4) the overhaul, modification, and modernization of fire control instruments, including radar attachments and their accessories.

The present staff of the plant consists of the original employees who were inducted into the Civil Service system at the time of conversion to naval control. Assigned to the plant are 11 naval officers and 5 enlisted men, and 1 Marine officer and 40 enlisted men. These officers and men serve in the following capacities at the plant: As Commanding Officer and Executive Officer, and in the Budget Office, the Security Division, the Safety Office, the Communications Office, the Supply and Fiscal Department, and the Medical Department.

The Bureau, Washington, D.C., is hereby notified of the
adoption of the following resolution:

That the Bureau of the Army, Washington, D.C., be and it is hereby

ordered to take the following action:

1. The Bureau of the Army, Washington, D.C., be and it is hereby

ordered to take the following action:

2. The Bureau of the Army, Washington, D.C., be and it is hereby

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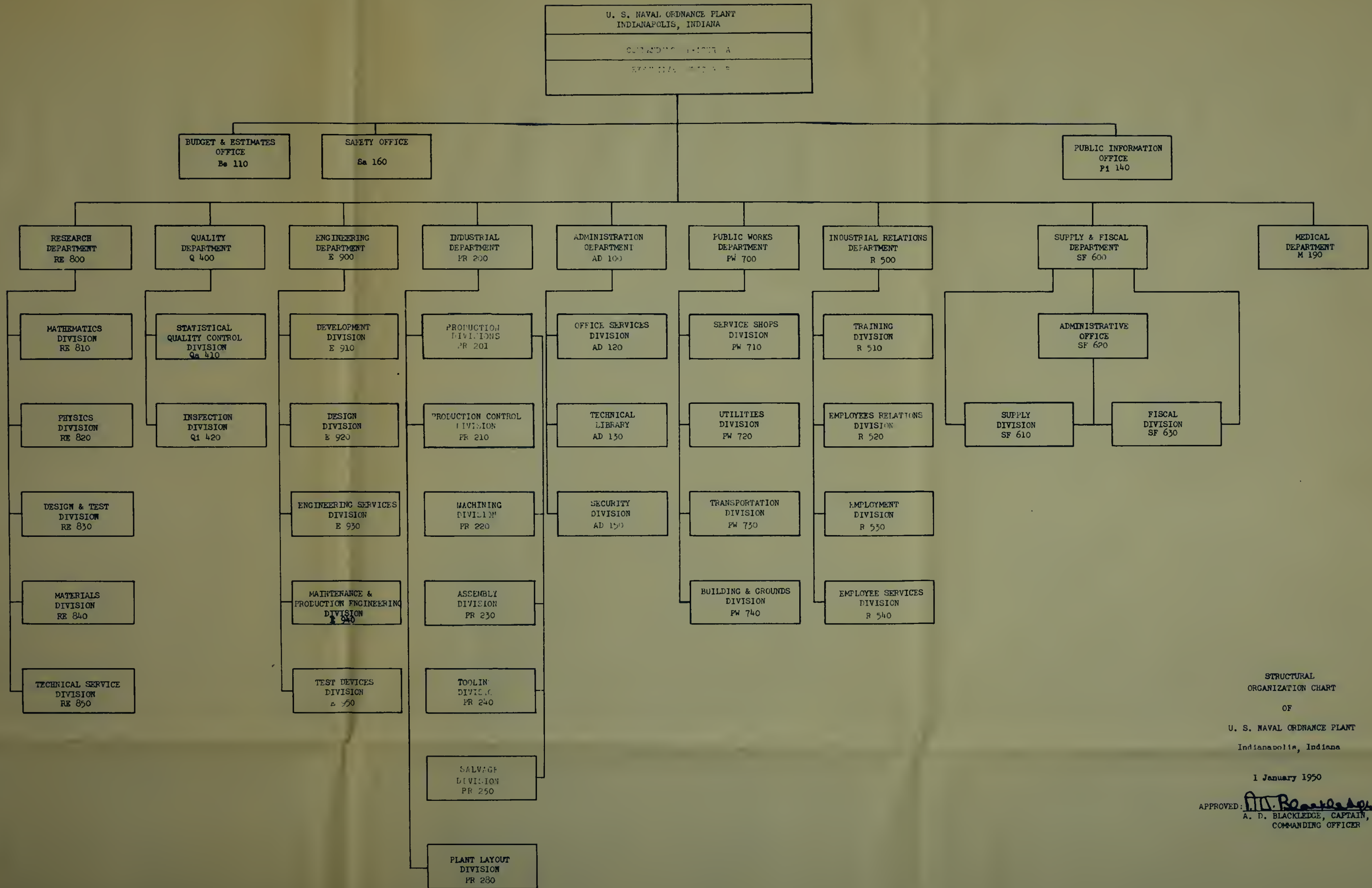
6. The Bureau of the Army, Washington, D.C., be and it is hereby

ordered to take the following action:

That the Bureau of the Army, Washington, D.C., be and it is hereby

Organized under the direction of the Commanding Officer with the assistance of the Executive Officer, the plant has nine departments. These departments are divided into divisions composed of sections, which are in turn subdivided into units. A structural organization chart of the plant at the divisional level appears in Figure 1.

Located in northeastern Indianapolis, Indiana, the plant occupies some one-hundred-sixty acres of land. Its main structure, the manufacturing building, is nine-hundred-twenty feet long and five-hundred-sixty feet wide, covering eleven and a half acres of floor space. The plant facilities are of the most modern type, including an air-conditioning system affording constant temperature and controlled humidity, with six complete changes of inside air cleared through an electrostatic filter in one hour. Heat is supplied by two oil-burning steam boilers. The lighting system employs both direct and indirect facilities, and maintains a one-hundred foot candle intensity at the work stations. These modern facilities afford to the plant's staff the maximum in comfort and ideal working conditions.



STRUCTURAL
ORGANIZATION CHART
OF
U. S. NAVAL ORDNANCE PLANT
Indianapolis, Indiana
1 January 1950
APPROVED: *A. D. Blackledge*
A. D. BLACKLEDGE, CAPTAIN, USN
COMMANDING OFFICER

The Nature of the Product

The product of the plant is aviation fire control systems, engineered and manufactured to meet service performance requirements and specifications. The mathematical expressions for the solution of various fire control situations are mechanized to a fine degree of accuracy. Mechanical and electronic methods translate the theoretical principles into useable systems.

A component unit of a fire control system is, in reality, a precision instrument. The exactness in the manufacture of a unit's individual parts is comparable to that employed by the most skilled toolmakers in industry.

There is a great variety of products among the aviation fire control systems. Thus, the system which is installed in a fighter to control the fire of its guns is vastly different from that installed in a high-altitude bomber to control the dropping of its bombs. The addition of controls for torpedoes, rockets, and air-launched guided missiles further increases the dissimilarity between the fire control systems.

The product of the plant is, therefore, precision instruments possessing little uniformity among themselves.

The present of the machine is a very serious question.

It is a question which is being asked by the public and by the government. The public is asking it because it is a question of the future of the machine. The government is asking it because it is a question of the future of the machine. The public is asking it because it is a question of the future of the machine. The government is asking it because it is a question of the future of the machine.

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There is a great variety of opinions about the future of the machine. Some people think that the machine will be a great help to the human race. Others think that the machine will be a great danger to the human race. Some people think that the machine will be a great help to the human race. Others think that the machine will be a great danger to the human race. Some people think that the machine will be a great help to the human race. Others think that the machine will be a great danger to the human race.

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The Problem of Production Control

The plant is engaged in a combination of the job shop and intermittent types of manufacture. This type of manufacture is characterized by the production of special orders and of a great variety of products in limited quantities. In a year's time, the plant may receive three-hundred special orders which will require the production of one-hundred-thousand different items in average quantities of twenty-five units per item.

Some of the factors which necessitate a complex production control system are:

1. Number of ultimate parts in the product.
2. Number of different operations on each part.
3. Extent to which processes are dependant, i.e., those which cannot be performed until previous operations have been completed.
4. Variation in capacity of machines for different classes of work. In many industries speed of machines varies according to the nature of the material being worked on.
5. Degree to which subassembly exists.
6. Degree to which customers' orders with specific delivery dates occur.
7. Receipt of orders for many small lots.¹

The fact that the product, aviation fire control equipment, is comprised of precision instruments having large variety among themselves accentuates the factors listed above.

The machine tools in the plant are of the general purpose type. On the whole, there is a surplus of machine tools. The special nature and complexity of the finished product necessitates the designing of special testing equipment. Normally, available commercial test equipment is modified to meet the plant's special needs. In some cases,

¹ Alford, L. P., Bangs, John R., Production Handbook, The Ronald Press Company, New York, N. Y., 1944, pp. 75.

The Problem of Production Control

The plant is subject to a considerable variation in the type and quantity of work it receives. This type of variation is usually reflected in the production of special orders which is a very small percentage of the total production. In a plant of this type, the plant management is faced with the problem of controlling the production of these special orders. It is necessary to have a system of control which will enable the plant management to control the production of these special orders. This system of control should be able to handle the production of these special orders in a way which will enable the plant management to control the production of these special orders.

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The machine tools in the plant are of the general purpose

type. In the plant, there is a machine of general purpose. The general purpose machine is of the type which is used for the production of special orders. This machine is of the type which is used for the production of special orders. It is necessary to have a system of control which will enable the plant management to control the production of these special orders.

however, test equipment must be designed from basic fundamentals.

The employees in the Machining and Assembly Divisions are skilled craftsmen. Each machinist is capable of operating several types of machine tools. The Assembly Division employees are, in many cases, qualified machine operators; and the machinists, in turn, are capable of doing assembly work. Thus, when the plant is overloaded with machine tool work, the Assembly Division employees can be transferred to the Machining Division. The control of such inter-division personnel is a function of the Production Control Division.

To summarize, the nature of the product, the special equipment required in its manufacture, and the skilled staff of the plant present complex problems which must be solved by the Production Control Division.

However, the following must be kept in mind:

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The Production Control Division

The Organization of the Production Control Division.

The Production Control Division, one of six divisions comprising the Industrial Department, consists of three sections, the Planning, Methods, and Progress Sections. Each of these is divided into various units. The organization chart of the Industrial Department, including the unit breakdown, appears in Figure 2.

The Responsibilities of the Production Control Division.

The Production Control Division plans and directs the scheduling of production activities; provides materials, tools, and specific manufacturing instructions for the operating shops; maintains daily floor checks to eliminate delays and work stoppages; moves stores and disposes of all manufactured items; is the source of all data on production performance, current and anticipated plant productive load, estimated productive and non-productive expenditures, current budget status of productive projects and the Industrial Department's maintenance allocations; acts in an advisory capacity in the matter of employment level and confers with the Engineering Department in the matter of product design for economical manufacture.

The responsibilities of the sections of the Production Control Division are as follows:

The Planning Section is charged with the responsibility of both long range and specific project planning and scheduling; the ordering of raw materials and purchased parts; the issuance of shop order kits; the preparation of charts and graphs indicating production performance trends, and other statistical production data; the compilation and reporting of production costs to provide comparison between the

The General Policy of the Department

The Department of the Interior, one of the oldest and largest of the Federal Government, is charged with the management of the public lands and the regulation of the Indian affairs. It is also responsible for the conservation of the natural resources of the country and for the promotion of the general welfare of the people.

The Department's Policy in the Management of the Public Lands

The Department of the Interior is charged with the management of the public lands and the regulation of the Indian affairs. It is also responsible for the conservation of the natural resources of the country and for the promotion of the general welfare of the people. The Department's policy in the management of the public lands is to preserve them for the use and enjoyment of the people and to protect them from waste and destruction. It is also responsible for the regulation of the Indian affairs and for the promotion of the general welfare of the Indian people.

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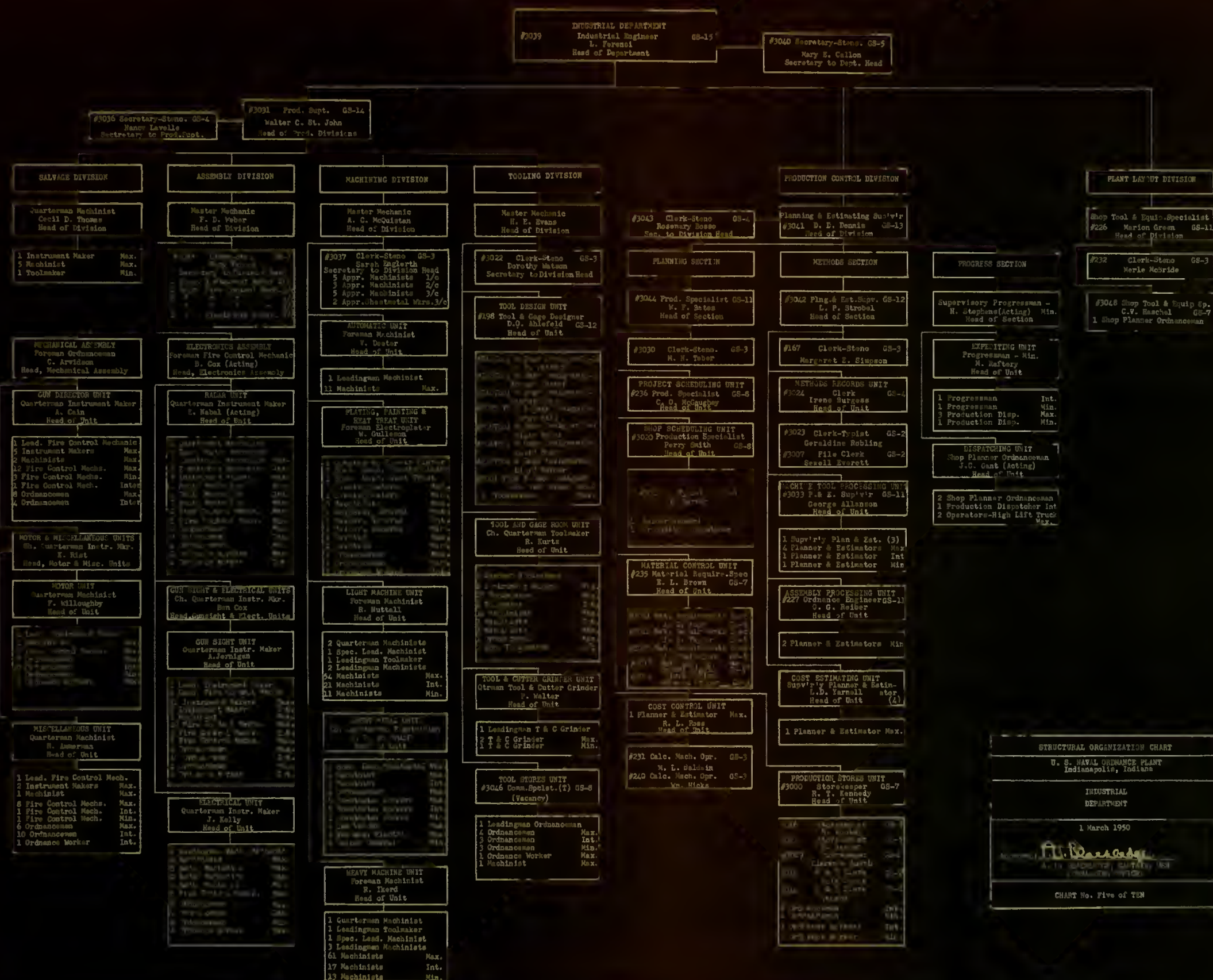


Fig. 2 Organization Chart of Industrial Department

original estimate and the actual expenditure; and the control of project expenditures.

The Methods Section is responsible for cost estimation for the proposed production work; the preparation of detailed process routing sheets (operation sheets) for component parts, sub-assemblies, finished units, and the necessary time to perform such operations; the ordering of all special tools and gages; the designing and ordering of special test equipment; conferring with the Engineering Department regarding changes of design which will facilitate production and lower costs; the receipt, recording, and distribution of engineering information to the Industrial Department; the advising of the Plant Layout Division regarding the placement of machine tool equipment; and the recommendation of procurement of specialized machine tool equipment and accessories.

The Progress Section is charged with the responsibility of distributing the shop order kits; insuring the completion of scheduled work on time; expediting the procurement of raw materials, tools, gages, and purchased parts; conferring with the various departments regarding solutions of production "bottlenecks;" reporting weekly the production status of projects; and the inter-divisional handling of materials.

Downloaded from <http://ajphaphysiol.physiology.org/> at University of California, San Diego on September 11, 2012

[illegible]

The program herein is designed with the responsibility of providing the user with the most efficient and effective means of obtaining the information required for the various operations mentioned herein. The program herein is designed with the responsibility of providing the user with the most efficient and effective means of obtaining the information required for the various operations mentioned herein.

The Handling of a Proposal

The Bureau of Ordnance, before allocating funds or authorizing a plant to begin work on a project, requires each plant interested in bidding on the work to submit an estimate or proposal as to the expected delivery date of the first completed item and the approximate cost of the project. Generally in letter form, the Bureau's request for this estimate is accompanied by rough prints and parts lists pertaining to the product, or by a word description of the product.

This letter is received and processed by the Budget Office of the plant administration. The Proposal or Cost Estimation and Scheduling Form (Blue), Figure 3, is originated in that office and accompanies the prints to the Engineering Department, where they are examined for the purpose of estimating an engineering release date. This date is then entered on the proposal.

From the Engineering Department the proposal and attachments then go to the Cost Estimating Unit of the Production Control Department, where all the remaining estimates, with the exception of the delivery schedule, are made. The Cost Estimating Unit fills in the cost estimate columns of the proposal in terms of dollars only. The method used to arrive at these estimates will be described later in a section on this unit.

When the above cost estimation is complete, the proposal is then returned to the Project Scheduling Unit, where an estimate is made as to where in the work load the project can be placed, when delivery on the finished products can be expected, and in what quantity they can be completed during each period until the project's termination.

The proposal and its accompanying papers are then returned to

The Committee on the Project

The Bureau of the Committee, before presenting the report

has a plan to begin work on a project, project which is

is being on the work to which an estimate of progress is

project delivery date of the first completed item and the

cost of the project. Generally is taken from the project's progress for

this estimate is not covered by much price and hence the

in the project, it is a most detailed at the project.

This table is revised and provided by the project office

the first administration. The project is then revised and

for from (from) there is a table in the office and

the table in the project's progress, which are

the project of delivery of the project's progress date. This date is

then revised on the project.

From the project's progress the project's progress

time to the first delivery date of the project's progress

shows all the project's progress, which are

estimated, are made. The first delivery date is

estimate of the project is made of delivery date. The

estimate of the project's progress will be

will.

When the project is revised, the project is

when revised to the project's progress date, which

is to be in the work of the project, which

on the project's progress can be

be completed after which project will the project's

The project and the project's progress will the project's

U. S. NAVAL ORDNANCE PLANT — INDIANAPOLIS

PROPOSITION _____

COST ESTIMATION AND SCHEDULING FORM

PROPOSITION _____

BuOrd Authority: _____

PROJECT ORDER NO. _____

EXPIRES _____

ORIGINATING DATE _____

CLASS OF ESTIMATE _____

JOB ORDER NO. _____

TASK: _____

REVISION DATE _____

Classification: _____

ITEM																									COST ESTIMATE										
	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	LABOR	MAT'L	MISC.	TOTAL	
ENGINEERING RELEASE																																			
PACKAGING RELEASE																																			
MOULDINGS & CASTINGS																																			
PROCESSING																																			
RAW MATERIAL																																			
PURCHASED ITEMS																																			
TOOLING																																			
MACHINING SECTION (HOURS)																																			
ASSEMBLY SECTION (HOURS)																																			
PACKAGING (HOURS)																																			
TOTALS (HOURS)																																			
DELIVERY SCHEDULE (PER MO.)																																			

Appropriation: - -

Expenditure Account: = =

OND-01, 3-1-40 15-1, 1

Fig. 3 Cost Estimation and Scheduling Form

the Budget Office for final review, issuance, and submission to the applicable activity.

These estimations and information are presented in general form and are regarded as a tentative commitment by the plant. They serve as a broad basis for planning by the Bureau of Ordnance, for cost estimation and approximate delivery schedules.

the subject of the trial, however, and the evidence of the

clinical activity.

These subjects and patients are presented in general form

and are reported as a separate group by the group. They are in a

group for the purpose of the study of the disease, but not for the

and appropriate delivery method.

The Handling of a Firm Estimate

When the Bureau of Ordnance has decided to authorize the plant to begin work on a project and has allocated the necessary funds, this authority and allocation come to the plant in the form of a project order number and an allotment number. These are received by the Budget Office and are processed in the same manner as was the information pertaining to a proposal.

The Firm Estimate or the Cost Estimation and Scheduling Form (White), Figure 4, is originated by the Budget Office and differs from the proposal only in color and the amount of information thereon. This form and current pertinent information, which may include more detailed prints and/or parts lists, are forwarded to the Engineering Department. The Engineering Department proceeds as expeditiously as possible with the work of originating production engineering releases without awaiting a formal job order. This precludes delay of the engineering release because of delay in issuing a job order. If the firm estimates are accompanied by a work description only, the Engineering Department develops the prints and parts lists. A revised engineering release date is made in greater detail than in the case of the proposal.

The originated or revised prints and parts lists are sent to the Methods Records Unit, who transmits a copy to the Material Control Unit. The Material Control Unit uses the information from the parts lists to determine whether the parts can be obtained from the Supply system or whether they will have to be procured in another manner.

This information, together with the firm estimate, is then passed to the Cost Estimating Unit. Using the information furnished by Budget, Engineering, and Supply, and their own internal work forms, the

13256

10/10/1944

Dear Sir,

I have the pleasure to acknowledge the receipt of your letter of the 10th inst. in relation to the above.

I am sorry that I cannot give you a more definite answer at this time, but I am sure that you will understand the necessity for this.

I am, Sir, very respectfully,
Yours faithfully,
J. H. [Signature]

Enclosed for you are two copies of the report of the Committee on the subject of the above.

I am, Sir, very respectfully,
Yours faithfully,
J. H. [Signature]

[illegible]

The following is a list of the names of the persons who have been identified as having been in contact with the subject of this investigation, and who have been identified as having been in contact with the subject of this investigation, and who have been identified as having been in contact with the subject of this investigation.

Cost Estimating Unit makes an accurate estimate of the costs that will be incurred in the process of manufacturing a complete project. This estimate is made as a result of more meticulous investigation than was afforded the proposal.

The Firm Estimate is then returned to the Project Scheduling Unit for processing similar, with a few exception, to that given the proposal. As well as estimating the delivery schedule, this unit breaks down each cost figure into man-hours and loads the firm order by months. Consideration is given to the total available man-hour capacity of the plant and to the already existing load when the loading of a new project is undertaken.

The completed Firm Estimate is then returned to the Budget Office for final review, issuance, and submission to the applicable activity.

As was noted in this discussion, the estimates and information presented are the result of extended investigation and are considered a definite commitment by the plant, since they are specific information pertaining to the Bureau's planning regarding costs and scheduled delivery dates.

The firm Cost Estimation and Scheduling Form for a project actuates the flow of work in the Production Control Division. There is a great exchange of information between Units which, if included in a general flow diagram, would become confusing, defeating the diagram's general purpose of giving an over-all picture of the work flow in the Production Control Division. Only the general pattern of the work flow is indicated and only the more important forms mentioned in the description of the functions of the various Units. The following diagram shows the general flow of work between the Units of the Production Control Division.

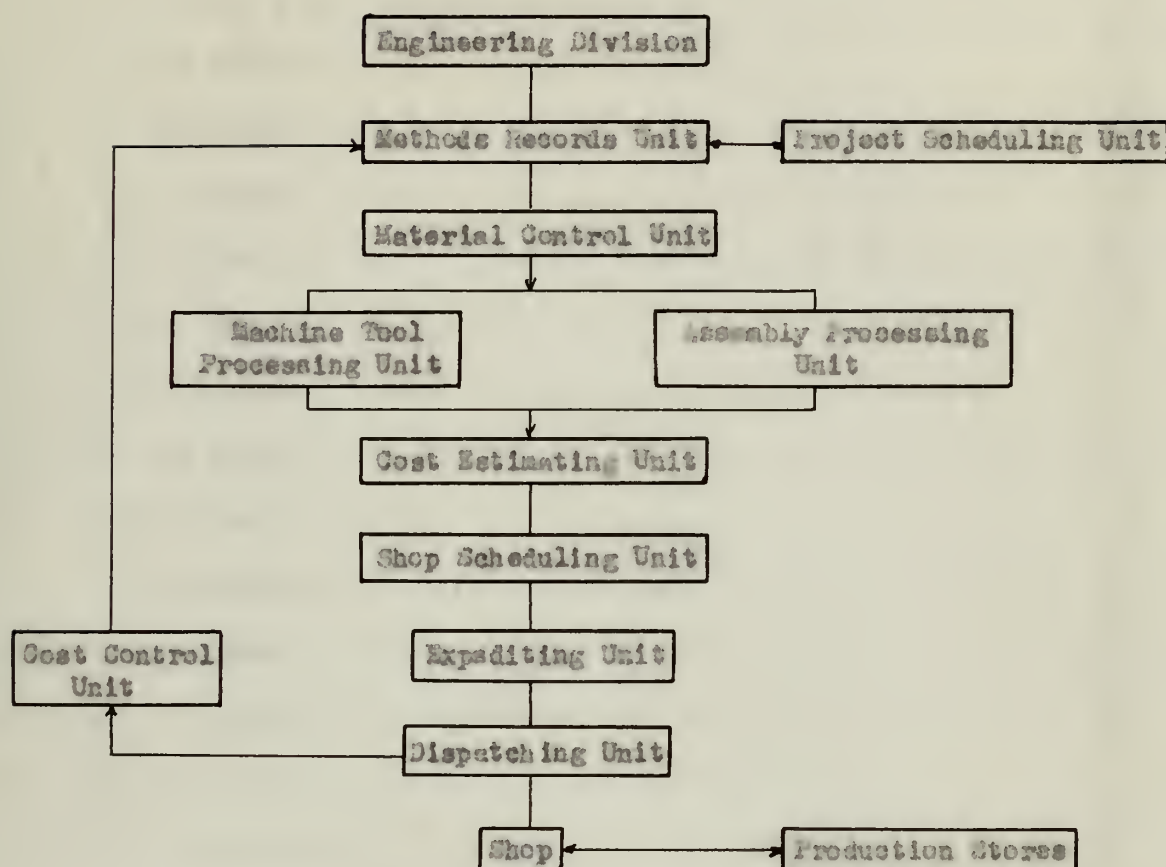
When the investigation was completed, it was found that the results of the investigation were not as satisfactory as had been hoped for. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been.

The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been.

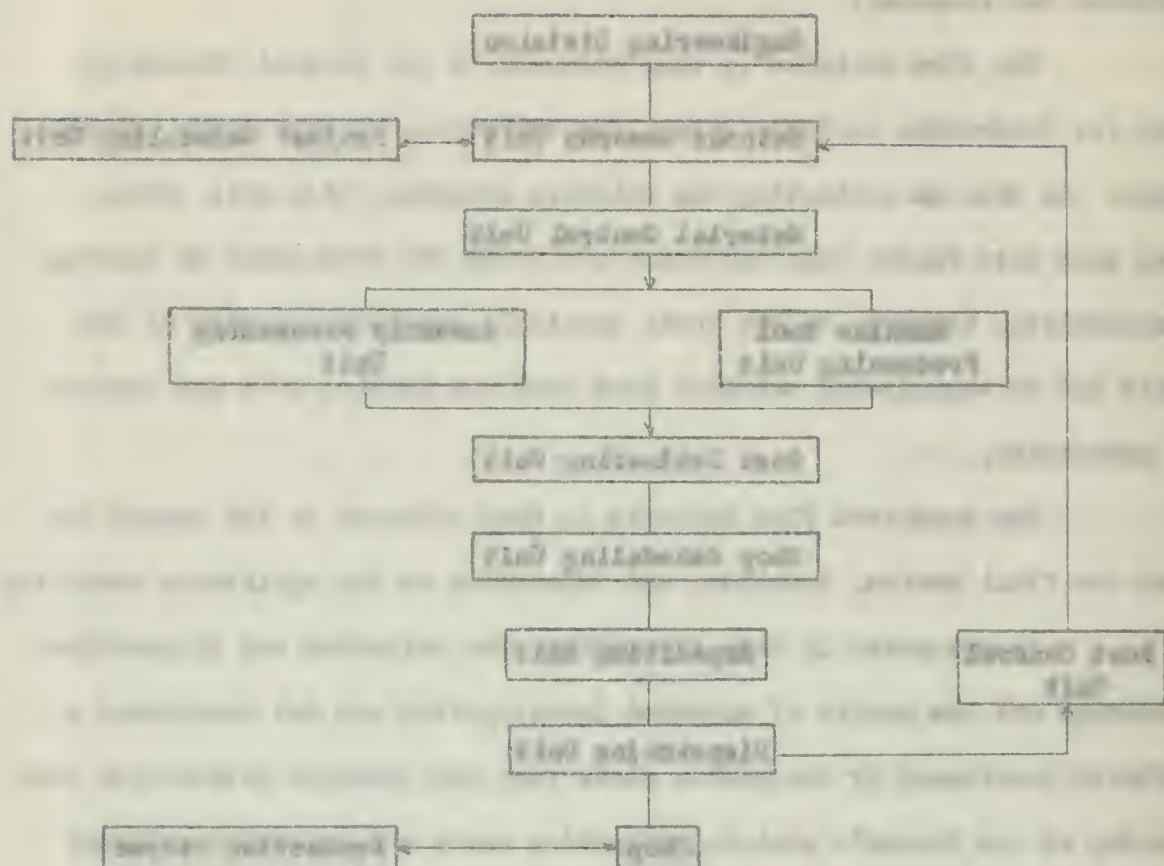
The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been.

The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been. The investigation was not as thorough as it should have been, and the results were not as complete as they should have been.

General Work Flow Diagram
Production Control Division



The functions of the various Units are described in the following pages.



The structure of the system is shown in the figure.

The system is designed to be flexible and scalable.

The system is designed to be secure and reliable.

The system is designed to be easy to use and maintain.

The system is designed to be cost-effective and efficient.

The system is designed to be future-proof and adaptable.

The system is designed to be user-friendly and intuitive.

The system is designed to be robust and resilient.

The system is designed to be transparent and accountable.

The system is designed to be innovative and creative.

The Project Scheduling Unit

The Project Scheduling Unit plans the over-all plant schedule, issues the internal scheduling for the Production Divisions, and compiles certain important production statistics which aid in formulating the plant's labor requirements.

The following forms are originated in the Project Scheduling Unit: The Internal Schedule Form, shown in Figure 5, indicates the required completion dates of a project. The information contained in this form is taken from the Cost Estimation and Scheduling Form, and is distributed throughout the plant. Each division advises the Unit as it completes its portion of the project, thus furnishing the Unit with an accurate record of the status of each project.

The Forecast of Productive Labor, Figure 6, is a chart which displays the over-all plant production forecast in terms of man-hours, projected eighteen months ahead. The data is divided into program numbers, and represents the load on the various departments. The main function of this chart is to determine the amount of new work which can be undertaken by the plant in the near future. The chart is sent to the Bureau of Ordnance via the plant administration.

The Load and Performance Chart, shown in Figure 7, represents the efficiency of the shop relative to the time estimates of the Cost Estimating Unit. This chart serves as an efficiency standard for the shop, showing the amount of work completed by the shop against the amount of work released to the shop by the Production Control Division. Sources of the chart's information are the Weekly Machine Load Report and the Fiscal Labor Report.

The Monthly Man Load Summary is in the form of a letter stating

The Project Director will provide the necessary financial assistance to the various institutions for the purchase of equipment and supplies.

The following items are contained in the project summary:

1. The project summary, which is divided into two parts: the project summary and the project summary.

2. The project summary, which is divided into two parts: the project summary and the project summary.

3. The project summary, which is divided into two parts: the project summary and the project summary.

4. The project summary, which is divided into two parts: the project summary and the project summary.

5. The project summary, which is divided into two parts: the project summary and the project summary.

6. The project summary, which is divided into two parts: the project summary and the project summary.

7. The project summary, which is divided into two parts: the project summary and the project summary.

8. The project summary, which is divided into two parts: the project summary and the project summary.

9. The project summary, which is divided into two parts: the project summary and the project summary.

10. The project summary, which is divided into two parts: the project summary and the project summary.

[illegible]

and the blood factor, the contents of the ship's latrine and the ship's food and drink were released in the way of the American Central Police, ship, showing the names of each released by the ship and the the witness of the ship relative to the first sentence of the case following this. This case shows an official statement for the the last and following ship, which is given by the witness.

The family we had chosen is a very good one.

J.C. #

Complete Engineering Release

Operation	Due	Complete
Final PD & BM's		
Make Routings		
Make Kits		
App'y Routings		
App'y Kits		
Get Materials		
Purchased Parts		
Make Parts		

Remarks:

- (1) If for any reason your portion of the above schedule cannot be met, please notify the undersigned immediately.
- (2) When your portion of the above schedule is completed, please date, initial and return this form to the undersigned.

C. O. McGaughey
Project Scheduling Unit

Fig. 3 Internal Schedule

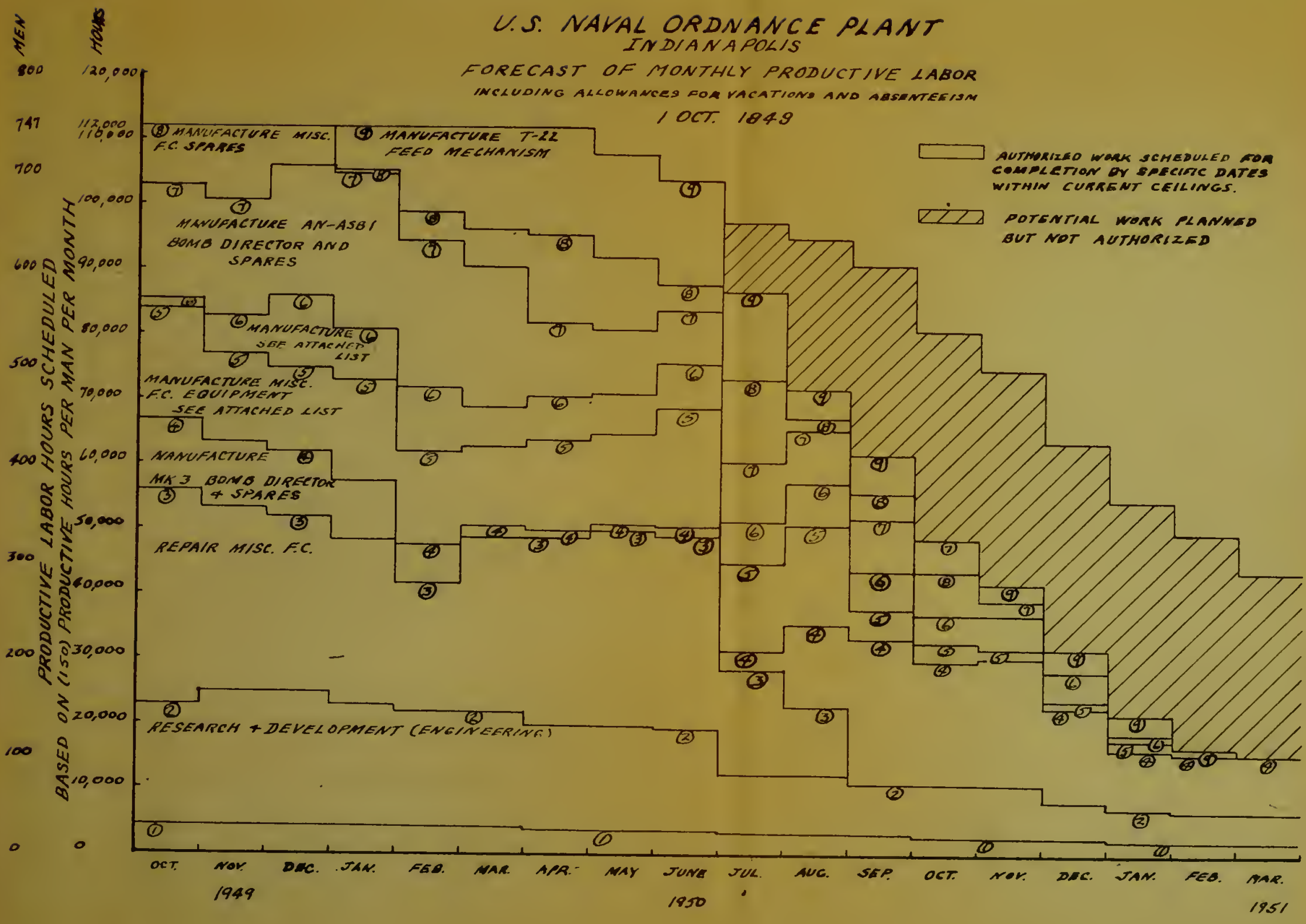


Fig. 6 Forecast of Productive Labor Chart

D-200 MAN LOAD & PERFORMANCE CHART

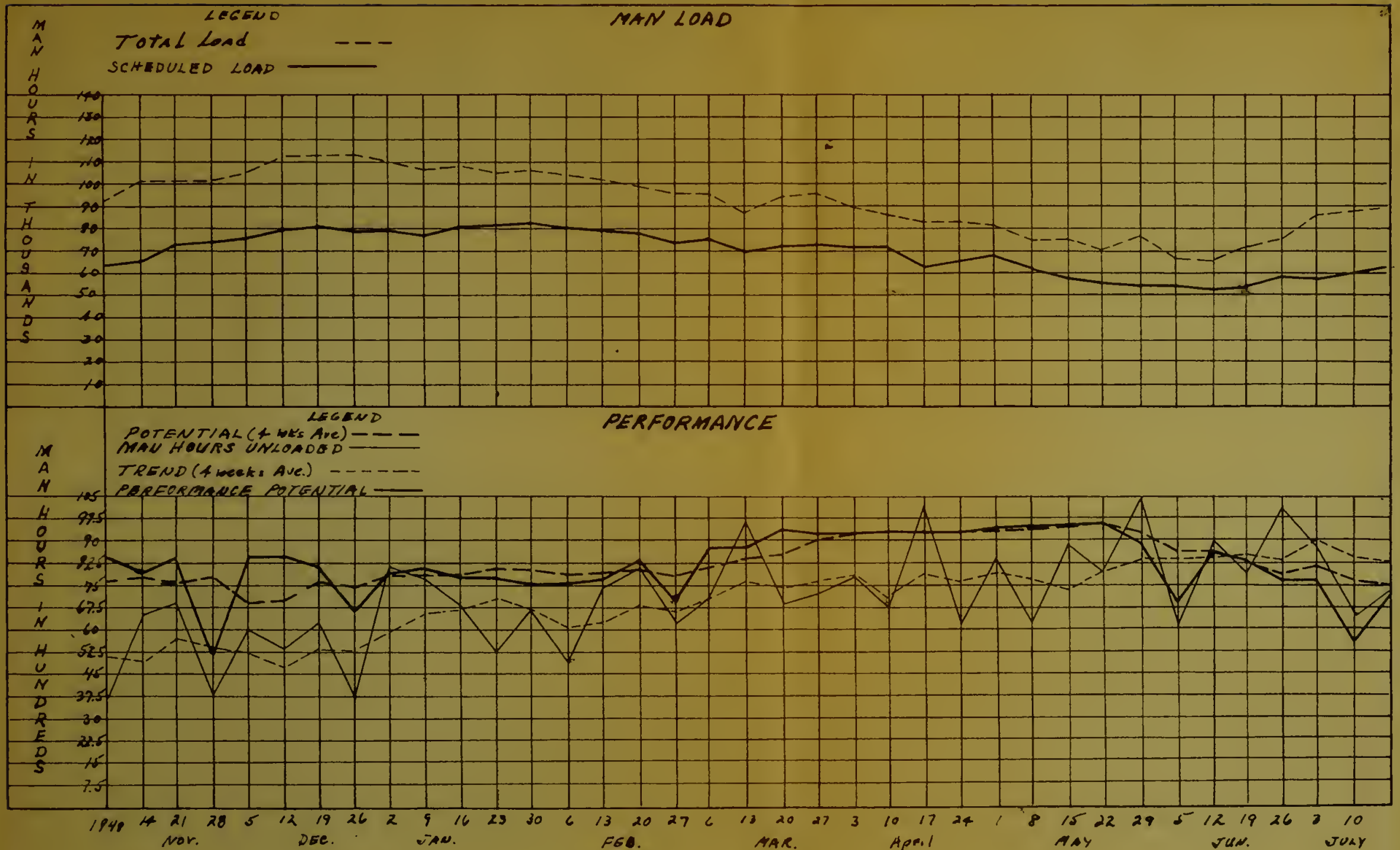


Fig. 7 Load and Performance Chart

the man-hours of machinery, assembly, and tooling completed in a month. Based on the Forecast of Productive Labor, this summary recommends transfers of labor between divisions and the adjustment of the labor force to meet the production requirements of the immediate future. It also contains a brief account of the status of all projects, a report on the important occurrences in and outside of the plant during the past month (such as a national coal strike), and their effect on the progress of the plant's various projects. This summary is used for administrative guidance.

The flow of information into the Unit, the forms originated therein, and their destination are shown in the diagram below.

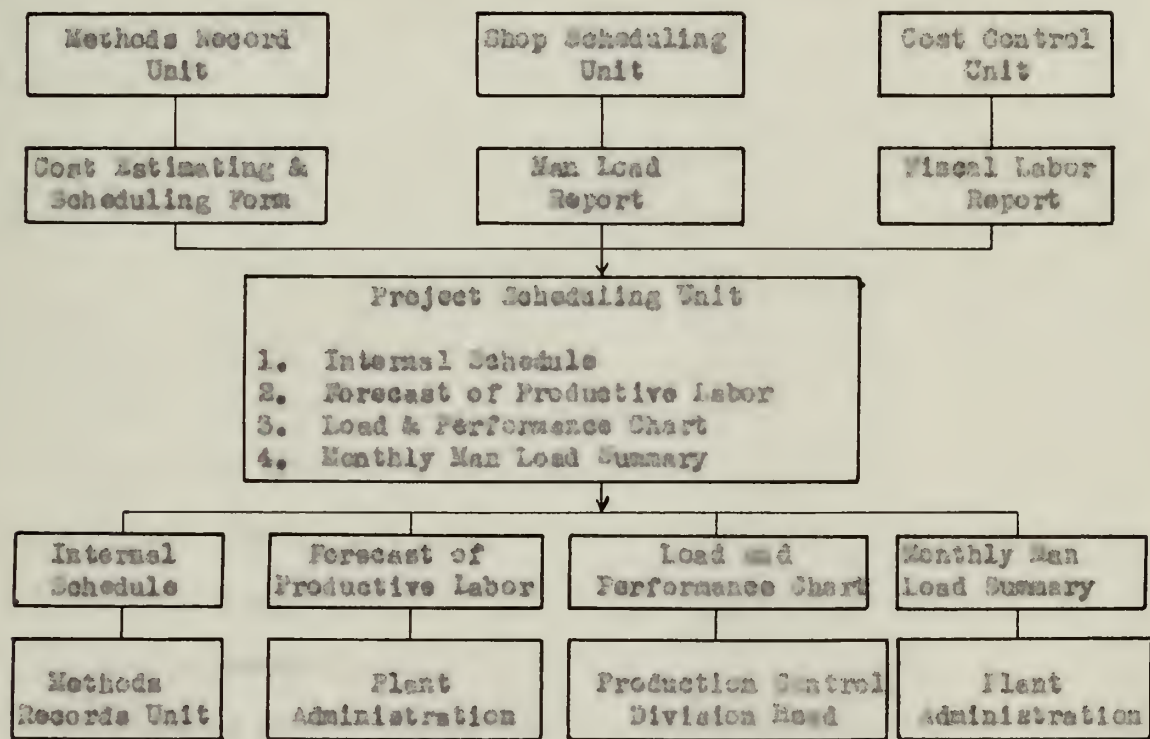
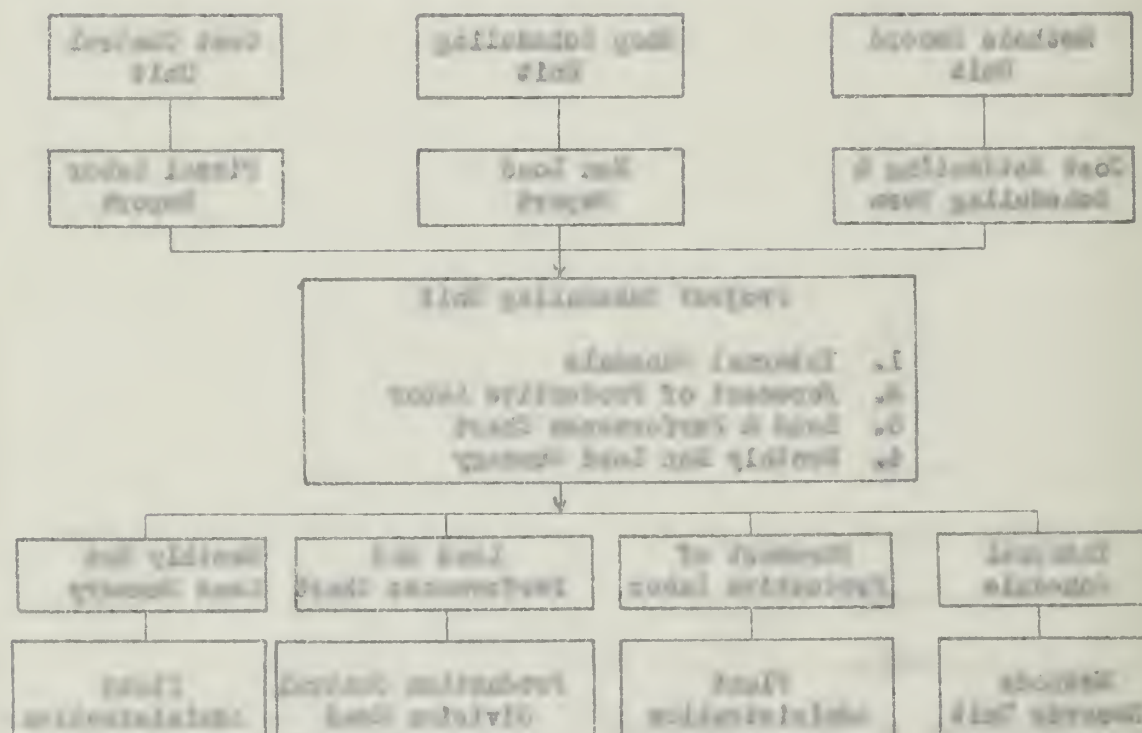


Figure 4. VI foldings for different α values. $\alpha = 0.0001$ (red), $\alpha = 0.0005$ (blue), $\alpha = 0.001$ (green), $\alpha = 0.005$ (cyan), $\alpha = 0.01$ (magenta).

of the plant's various projects. The company is now the
owner (and is a national steel worker), and their effort is the
to the largest business in the world of the steel industry. The
also involves a brief account of the state of the world, a report
there is much the production requirements of the business. It
importance of labor relations and the objectives of the labor
based on the concept of productive labor, this company promotes

The Bureau of Information also has the honor to acknowledge

There is no doubt that the information is correct.



The Methods Records Unit

The Methods Records Unit is responsible for receipt, stowage and distribution of Engineering data and for keeping the many files up to date. These files contain a variety of items, such as job orders, blueprints, parts lists, production breakdown sheets, and many others. One of the other responsibilities of the Unit is to act as a collecting agency in making up the "folders" that are originated to implement the production of a new part. It is obvious that it is necessary to have some means of keeping track of just how each job is progressing pertaining to the necessary preparation of prints, routings, and such other work that must be completed prior to release of the job order to the Shop Scheduling Unit. The Methods Records Unit accomplishes these functions.

When a new part appears on the Production Breakdown Sheet, a folder containing the necessary information on the part is made up and sent to the Machine Tool Processing Unit where the Process Routing Sheet is made up on vellum paper. This accompanies the folder and is then sent to the Cost Estimating Unit via the Methods Records Unit so that they are able to tell at all times just what progress is being made on the "folder." The Cost Estimating Unit fills in the operator and set-up times in the proper columns on the Process Routing Sheet, and the folder is then returned to the Methods Records Unit for reproduction and distribution of the Process Routing Sheet. The folder is kept in a current file as long as the part is being produced in the plant.

Items of different form are received by the Unit, reproduced in the required number and distributed according to the needs. For instance, Parts Lists are reproduced and sent to the following:

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

The method described in this report is a preliminary one, and is intended to give a general idea of the possibilities of the method. It is not intended to be a final report, but rather a preliminary one. The method described in this report is a preliminary one, and is intended to give a general idea of the possibilities of the method. It is not intended to be a final report, but rather a preliminary one.

[illegible]

1. Original to file
2. Material Control
3. Assembly
4. Methods Processing

Blueprints are reproduced and sent to the following:

1. Original to file
2. Tool Design
3. Salvage
4. Machine Shop
5. Assembly

Process Routing Sheets are reproduced and sent to the following:

1. Original vellum into file
2. Machine Shop
3. Assembly
4. Inspection
5. Tool Design
6. Tool Room
7. Scheduling
8. Salvage

1. Original to the U.S. Government
2. Original to the U.S. Government
3. Original to the U.S. Government
4. Original to the U.S. Government

Original to the U.S. Government and sent to the following:

1. Original to the U.S. Government
2. Original to the U.S. Government
3. Original to the U.S. Government
4. Original to the U.S. Government
5. Original to the U.S. Government

Original to the U.S. Government and sent to the following:

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2. Original to the U.S. Government
3. Original to the U.S. Government
4. Original to the U.S. Government
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The Material Control Unit

The Material Control Unit requisitions the raw materials and purchased parts required for the plant's production. It is responsible for initiating the screening of the supply system for available material, and for determining the component parts and their quantity to be manufactured in the plant.

In the interest of an economical material cost, the Unit, assisted by the Supply Department, investigates the required raw materials and purchased parts to determine the materials available in the extensive supply system. For this purpose the Unit originates the Firm Requirement and Obligation of Material Form, Figure 8. When the required material is available, the Unit requisitions it through the Supply Department, the procuring agency for raw materials and purchased parts.

The Production Breakdown Sheet, Figure 9, is issued by the Unit. This sheet contains information as to the quantity of each component part of a project, determined by the Unit from the parts list, prints, and an estimation of scrap and losses. The Production Breakdown Sheet, the authorization to manufacture a specific quantity of a component part, is widely distributed throughout the Production Control Division.

Also issued by the Unit is the Stub Requisition, Figure 10, for raw materials and purchased parts. It is the Unit's request for the Supply Department to procure the required raw material or purchased parts, either from the supply system or from a commercial concern.

The following diagram shows the flow of information into the Material Control Unit, the forms it originates, and the information which leaves the Unit.

THE UNITED STATES OF AMERICA
DO hereby certify that
the within and foregoing is a true and correct
copy of the original as the same appears on the records
of the Department of the Interior, at Washington, D. C.

The following is a list of the names of the persons who have been appointed to the various positions in the Department of the Interior, and who have been sworn in as such.

Only the most limited information is available on the quality of the water in the area. The water is generally of good quality, but there are some areas where the water is of poor quality. The water is generally of good quality, but there are some areas where the water is of poor quality. The water is generally of good quality, but there are some areas where the water is of poor quality.

[illegible]

9NDGL, 4-13-49, 3M

Fig. 8 Firm Requirement and Obligation of Material Form

Date	Description	Amount	Balance
1900			
Jan 1	Balance forward		
Jan 2	Jan 1		
Jan 3	Jan 2		
Jan 4	Jan 3		
Jan 5	Jan 4		
Jan 6	Jan 5		
Jan 7	Jan 6		
Jan 8	Jan 7		
Jan 9	Jan 8		
Jan 10	Jan 9		
Jan 11	Jan 10		
Jan 12	Jan 11		
Jan 13	Jan 12		
Jan 14	Jan 13		
Jan 15	Jan 14		
Jan 16	Jan 15		
Jan 17	Jan 16		
Jan 18	Jan 17		
Jan 19	Jan 18		
Jan 20	Jan 19		
Jan 21	Jan 20		
Jan 22	Jan 21		
Jan 23	Jan 22		
Jan 24	Jan 23		
Jan 25	Jan 24		
Jan 26	Jan 25		
Jan 27	Jan 26		
Jan 28	Jan 27		
Jan 29	Jan 28		
Jan 30	Jan 29		
Jan 31	Jan 30		
Feb 1	Jan 31		
Feb 2	Feb 1		
Feb 3	Feb 2		
Feb 4	Feb 3		
Feb 5	Feb 4		
Feb 6	Feb 5		
Feb 7	Feb 6		
Feb 8	Feb 7		
Feb 9	Feb 8		
Feb 10	Feb 9		
Feb 11	Feb 10		
Feb 12	Feb 11		
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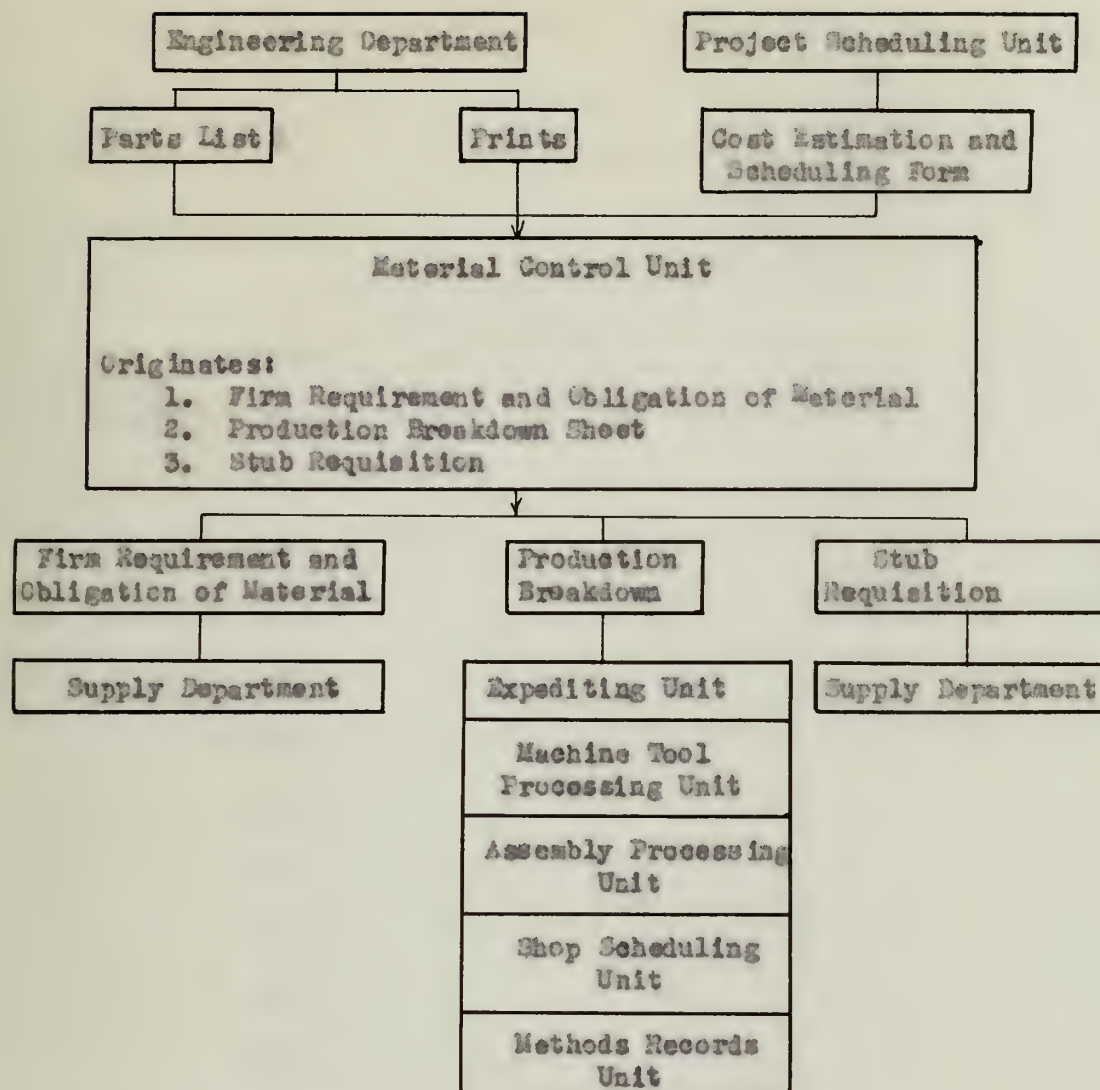
Fig. 10 Stub Requisition

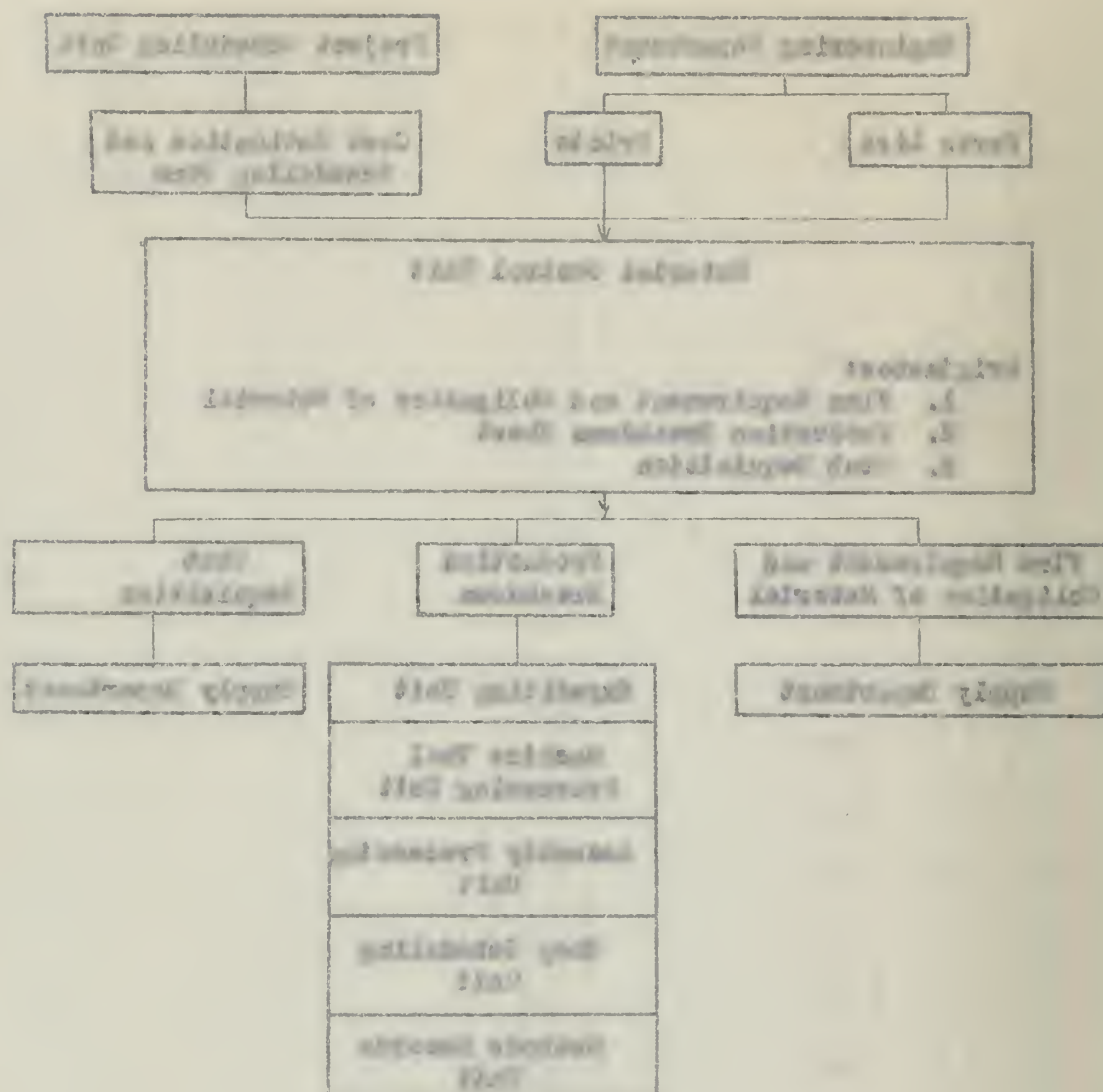
STUB NO.	SHOP	SHIP OR STATION	JOB ORDER NO.	WORK CLASS.	APPROPRIATIONS CHARGEABLE	PROJ. OR ALLOT.	OBJ. CLASS	ACCT. EX. PENDED FROM	DATE
UNIT OF ISSUE	QUANTITY	UNIT PRICE	EXTENSION	CLASS AND STOCK NUMBER	DESCRIPTION				
TOTAL				DELIVERY POINT		MISCELLANEOUS			
PRIORITY INDICATOR	APPROVED BY	ISSUED BY (DATE)	REC. VOUCHER NO.	RECEIVED BY					
DATE DEL. Y. DESIRED	SCHEDULE	LEAVE STOCK CONTROL	LEAVE STORES	LEAVE DELIVERY	DATE	SIGNATURE			
						DELIVER AND CHARGE AS INDICATED			
						SIGNATURE			

STUB REQUISITION NAV. S. AND A. FORM 129(9M) (REV. 2-48)

1







The Machine Tool Processing Unit

The Machine Tool Processing Unit originates the operation sheet for each component part to be manufactured in the plant, and issues requests for the designing and building of the special tools, jigs, fixtures, and gages required in the manufacture of these component parts.

This unit performs the work normally assigned in industry to the Production Planning Department. The Process Routing (or operation) Sheet, Figure 11, is one of the most important records kept by a manufacturing company, representing the "know-how" in the manufacture of component parts. It is formulated from the Parts List, Production Breakdown, and Internal Schedule received by the Unit.

The Tool Design and Build Order Form, Figure 12, is originated in the Unit from the information contained in the Parts List, the Production Breakdown, and the Process Routing Sheet. It outlines in general terms the tools, jigs, fixtures, and gages which the Tooling Division designs and builds for the manufacture of the component parts.

The following diagram shows the flow of information to the Machine Tool Processing Unit, the material originated in the Unit, and the next destination of that material.

The American Book Company has been for many years the largest publisher of books in the United States. It has a long and successful record in the publication of books for the general public, and its books are sold in every part of the world. The company's success is due to its high quality of work, its wide range of subjects, and its low prices. It has a large staff of writers and editors, and its books are published in a variety of languages. The company's books are sold in every part of the world, and its success is a testament to its high quality of work.

This book is one of the many fine books published by the American Book Company. It is a book of facts and figures, and it is written in a clear and concise style. The book is divided into two parts, the first part dealing with the history of the book, and the second part dealing with the future of the book. The book is a valuable addition to any library, and it is a book that should be read by every student of the history of the book.

The American Book Company is a company that has been successful for many years. It is a company that has a long and successful record in the publication of books for the general public, and its books are sold in every part of the world. The company's success is due to its high quality of work, its wide range of subjects, and its low prices. It has a large staff of writers and editors, and its books are published in a variety of languages. The company's books are sold in every part of the world, and its success is a testament to its high quality of work.

REQUEST FOR TOOL DESIGN AND BUILD ORDER
N 485 (Rev. 11-49)

DATE				UNIT TYPE
J.O. NO.	APPR. NO.	ACCT.	S. D. ITEM	DATE WANTED
S.A. NO.	ENK.	PART NO.	OPER. NO.	ROUTING DATE
SHOP ORDER NO.	MACH.	UNIT NO.	MATERIAL	NO. PARTS

NOTE: Sketch of work to be done should accompany the order if possible showing critical dimensions.

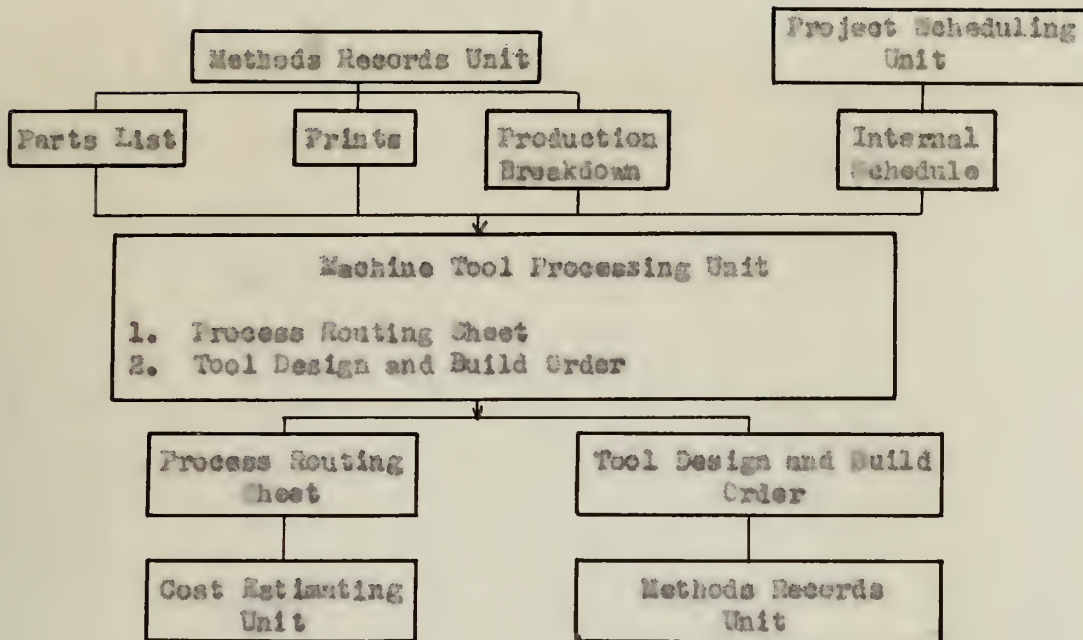
DESCRIPTION OF TOOL TO BE MADE

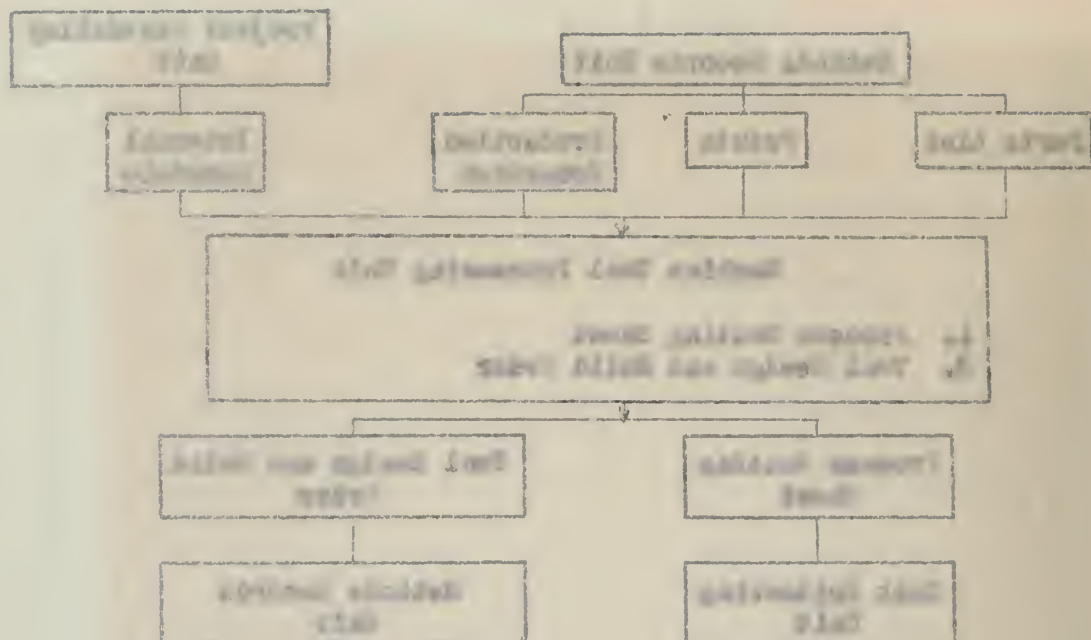
DESIGN COMPLETED	REQUESTED BY	APPROVED BY
<input type="checkbox"/> NO. 1 COPY-METHODS	<input type="checkbox"/> NO. 2 COPY - TOOL DESIGN	<input type="checkbox"/> NO. 3 COPY - TOOL STORES

Fig. 12 Tool Design and Build Order Form



Fig. 18. (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) (n) (o) (p) (q) (r) (s) (t) (u) (v) (w) (x) (y) (z)





The Assembly Processing Unit

The Assembly Processing Unit originates the assembly operation sheet and issues orders for the tools, jigs, fixtures, gages and test equipment required for the assembly process.

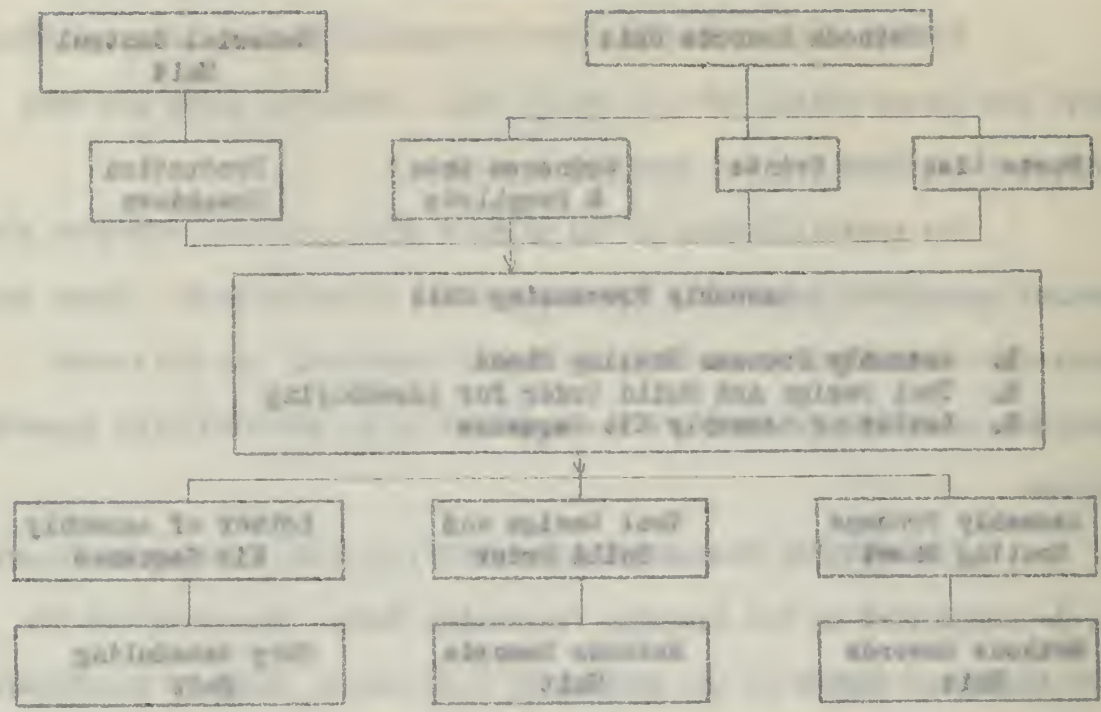
The specialization of the plant's final product, aviation fire control equipment, requires a great amount of assembly work. Since the knowledge of instrument assembly is highly technical, the Unit must provide a detailed write-up of the assembly of an aviation fire control system.

The Assembly Process Routing Sheet, in form similar to Figure 11, is originated in the Assembly Processing Unit. Experience is the most important factor in the writing of this sheet, which is constructed from the information contained in the Parts List, the Prints, and the Production Breakdown Sheet.

The Tool Design and Build Order Form, similar to Figure 12, is based on information from the Parts List, Prints, and Assembly Process Routing Sheet. The Assembly Process Routing Sheet also includes details of the required inspections; the Unit orders the special test equipment for these inspections. In some cases available commercial equipment is modified for this purpose, while in others special test equipment must be designed.

Equipment must be assembled in a definite sequence of operations; the Shop Scheduling Unit is furnished this information in the form of a letter, the Letter of Assembly Kit Sequence, which is a guide to the proper sequence of issuing the Assembly Kit.

The following diagram shows the flow of the more important information into the Unit, the material originated in the Unit, and the information departing from it.



The Cost Estimating Unit

The Cost Estimating Unit originates an estimated cost of each project undertaken by the plant, including the project's direct labor and material costs.

The component parts to be manufactured in the plant are estimated from information received from the Material Control Unit and other sources. The Cost Estimate Work Sheet, Figure 13, is used to compile data and compute total costs; this information is transferred to the Cost Estimation and Scheduling Form.

Probable operations and the time required for each are estimated by the Unit. The Machine Tool Processing Unit and the Assembly Processing Unit assist in the estimation of the operations required for the manufacture of each component part. This data is entered on the Estimate Routing Sheet, Figure 14.

The time in man-hours required for each operation, including the machine tool set-up time is estimated from past experience by the Unit.

As an aid to the maintenance of an accurate estimate of labor time required for each operation, the Unit records the actual time required at the completion of the job. With this information available, the Unit is able to keep current the time estimates in relation to the actual operation time. The estimated times are recorded on the Cost Estimate Work Sheet and the Process Routing Sheet.

The Unit keeps the Material Cost Card, Figure 15, for the purpose of estimating the project's material cost. Information from the purchase orders, which contain the current cost of materials, is transferred to the Material Cost Card which furnishes an up-to-date

The first author has been partially supported by a grant from the National Science Foundation (NSF) (DUE-9732282).

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...and the ...

THE UNIVERSITY OF CHICAGO PRESS

[illegible]

— *Journal of the American Medical Association*, 1934, 102, 1021.

[illegible]

THE UNIVERSITY OF CHICAGO

Probable operating cost: \$100,000

Revised by the author in 1971 and 1972.

and the other two are the same as the first two.

and the following are the names of the persons who have been named in the above list:

THE NEW YORK PUBLIC LIBRARY
ASTOR LENOX TILDEN FOUNDATION
500 5TH AVENUE
NEW YORK 17, N.Y.

...and the ...

442

could be a valuable addition to the information set of the user.

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COST ESTIMATE WORK SHEET

SHEET OF SHEETS

PARTS LIST NO.

PROP. NO.

PJO NO.

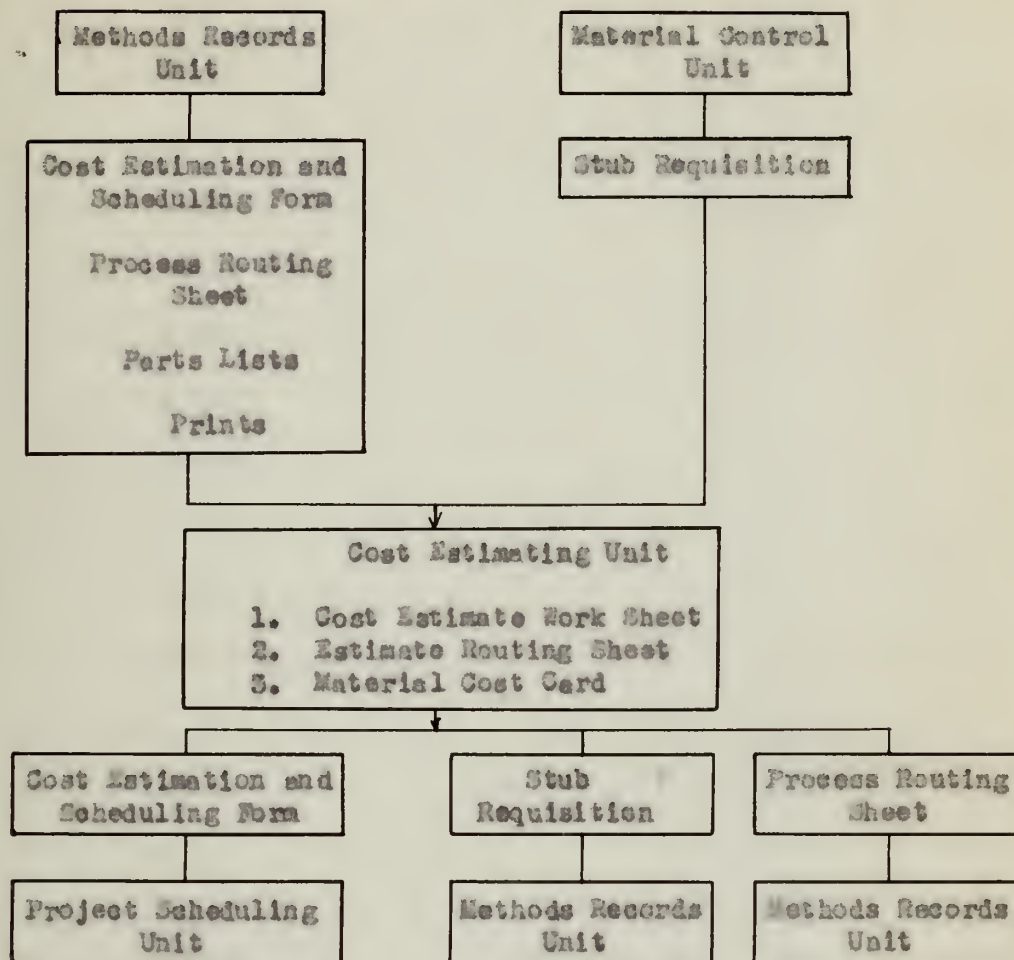
P. OR R NO.

DATE _____

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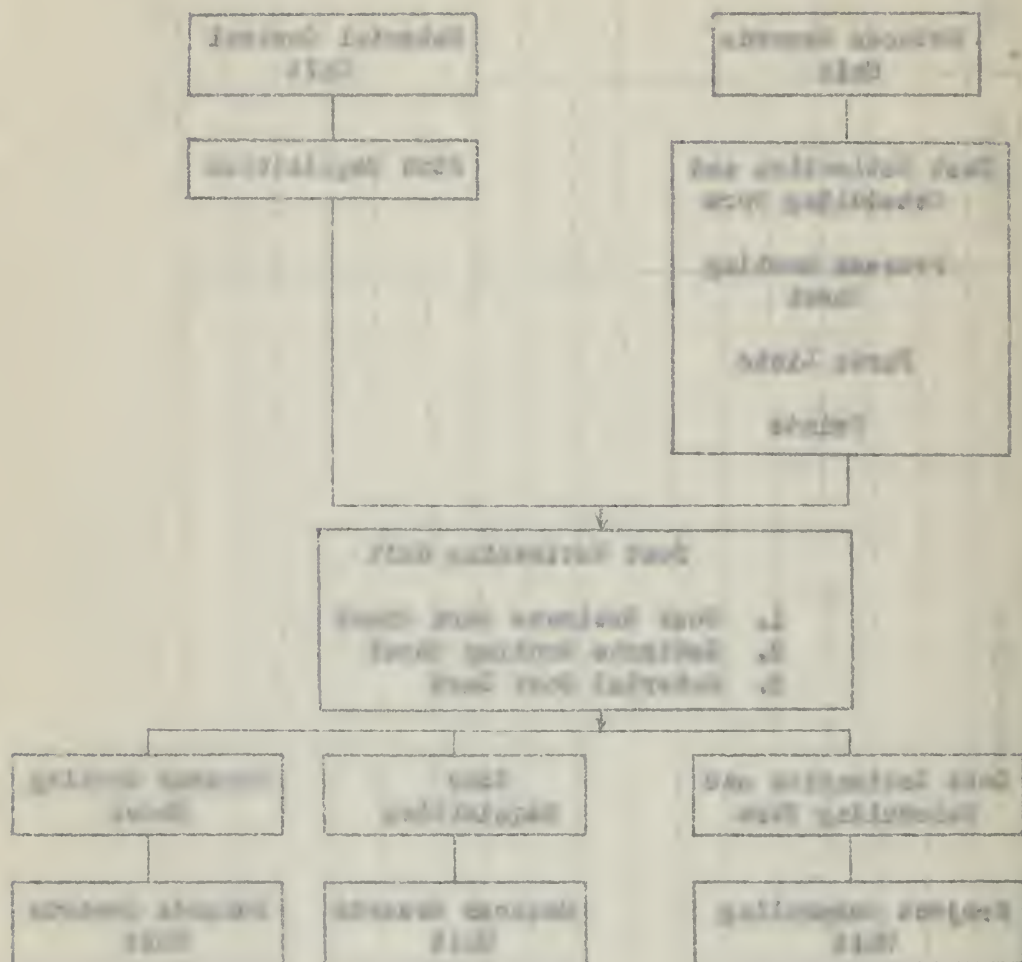
record of material costs for the Unit.

The following diagram shows the flow of information into, through, and out of the Cost Estimating Unit.



The following diagram shows the flow of information from

Source, and out of the Data Processing Unit.



The Shop Scheduling Unit

The Shop Scheduling Unit assigns to the Machining Division the manufacture of the component parts and to the Assembly Divisions the assembly of these parts into completed items. The Unit maintains a current record of work load in man-hours, which forms the basis for the addition of new work to the shop.

Figure 16 shows the Shop Order Kit, the shop's authority to manufacture a component part on assembly. This form is compiled from information contained in the Process Routing and Production Breakdown Sheets and the Internal Schedule Form. The required month date of the component part's completion is given on the Shop Order Kit. The shop is thus scheduled for work by months in terms of man-hours. The Shop Order Kit consists of eight vari-colored IBM cards, each color having a specific usage. The yellow material identification card is the master card, accompanying the shop order from raw material to completed component part; the green card is the material requisition card, etc.

The Weekly Machine Load Summary, Figure 17, is issued by the Unit. It serves as a means of determining the relative operating efficiency of the various units of the Production Division, and is the basis for adding new work to the shop and adjusting potential man-hours of labor between the Production Divisions. This report contains information on the number of man-hours released to and completed by the shop, and the present amount of work available for the shop.

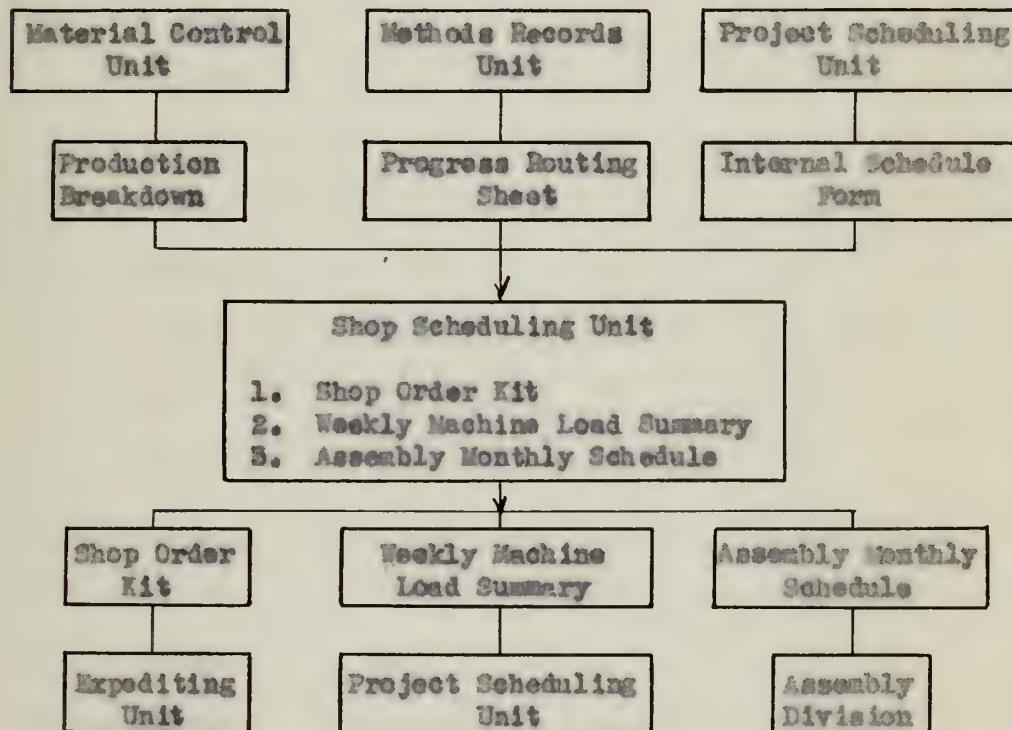
The Unit issues the Assembly Monthly Schedule which establishes the sequence of work to be accomplished by the Assembly Division during a month. Since there are many unpredictable time-consuming variables in the assembly of a highly complex instrument, the Assembly

113. *ibid.* 2008. 11. 20. 11. 20. 11. 20.

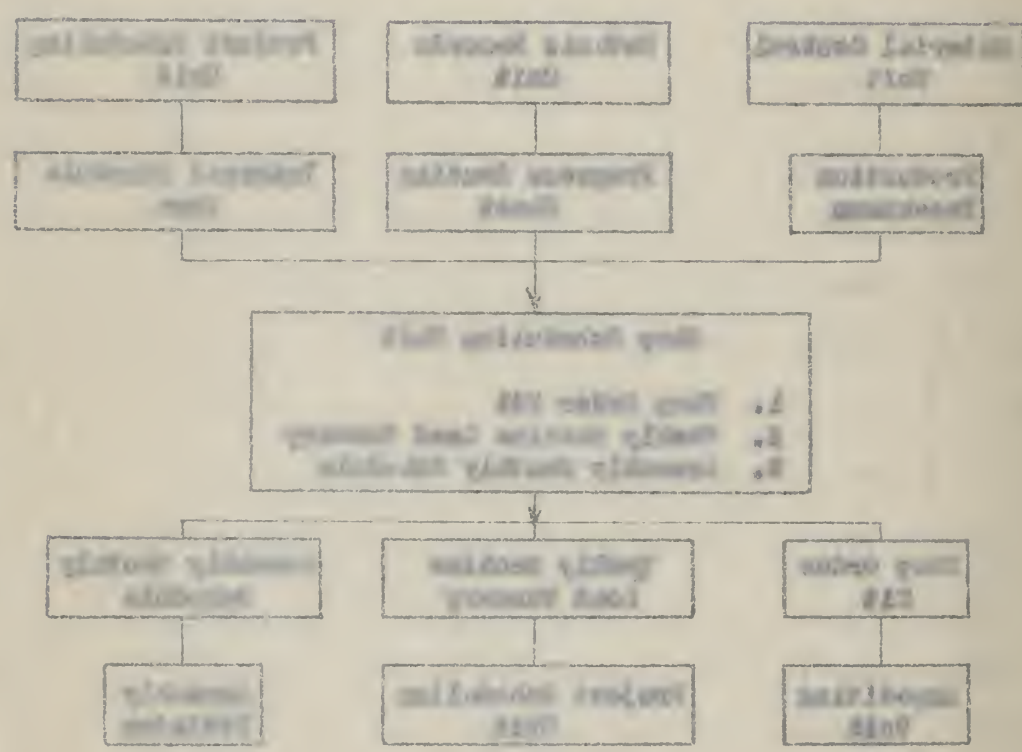


Division is not scheduled for work in terms of man-hours per month. The probable time required is available in a rough estimate, from which data the Assembly Monthly Schedule lists the projects' priorities and the required monthly delivery rates of the assembly units. Normally the Assembly Monthly Schedule overloads the Assembly Divisions in terms of man-hours of assembly work.

The important forms received in, originated by, and sent from the Unit appear below.



Division is not intended to be a part of business but rather
 the probable time required is estimated in a more realistic way than
 before the assembly process. It is the purpose of this study to
 the various assembly delivery rates of the assembly plant. It is
 the assembly plant's business to assemble products in order
 to maintain an assembly plant.
 The important items required in addition to the main items
 are given below.



The Expediting Unit

The Expediting Unit is charged with the responsibility of seeing that the materials for a shop order are located physically in the plant prior to sending the shop orders to the shop and that all shop schedules are met. The Expediting Unit initiates suggestions for substitute materials, and originates requests for new work to replace the "rejects" on job orders.

In order to prevent confusion in the shop, Shop Order Kits are not released for manufacture until the necessary raw materials for them have been received in the plant.

After receiving the Shop Order Kit from the Methods Records Unit, the Expediting Unit holds the kit until the Stub Requisition Receipt is received. This receipt is issued by the Supply Department after the material has been received. The Unit maintains a record of all Shop Order Kits and the required material for each; it also makes a weekly check of all kits being held up because of a lack of materials. A bi-monthly record of all such held-up kits is sent to the Head of the Production Control Division. The Unit expedites the procuring of materials through the Supply Department. In some cases, the Unit originates a substitute material upon the approval of the Methods Section or the Engineering Division. In other cases, such a suggestion for substitutes comes from the shop or the Supply Department; the Unit is responsible for having these suggestions approved by the Methods Section or the Engineering Division.

When parts are rejected by the Inspection Division and scrapped by the Salvage Division, the information is recorded on the back of the Master Card in the Shop Order Kit. After the Expediting Unit receives

The Department will be pleased to receive any information you may have regarding the above mentioned matter.

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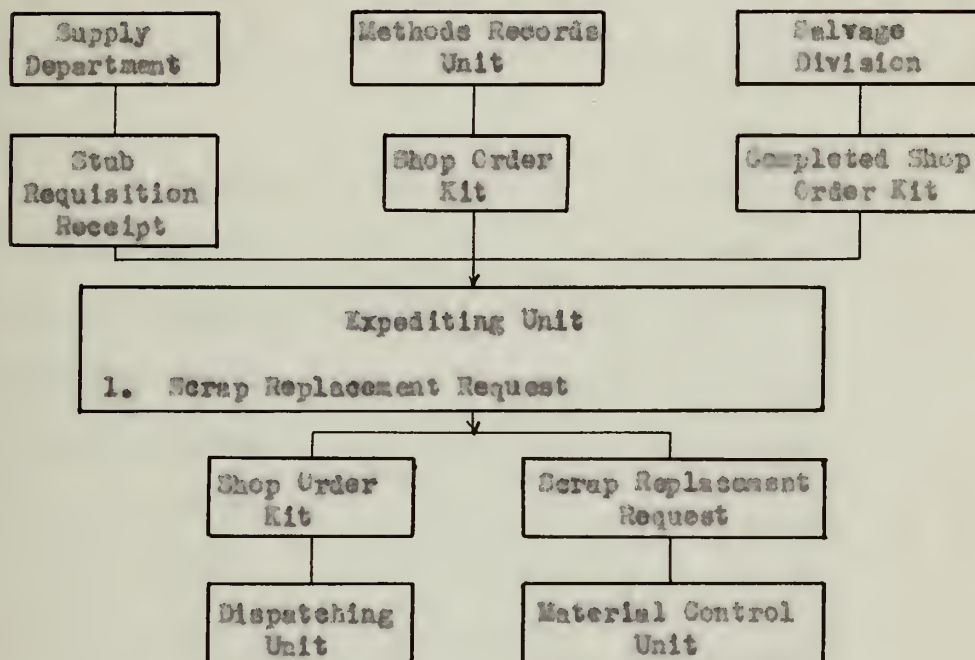
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[illegible]

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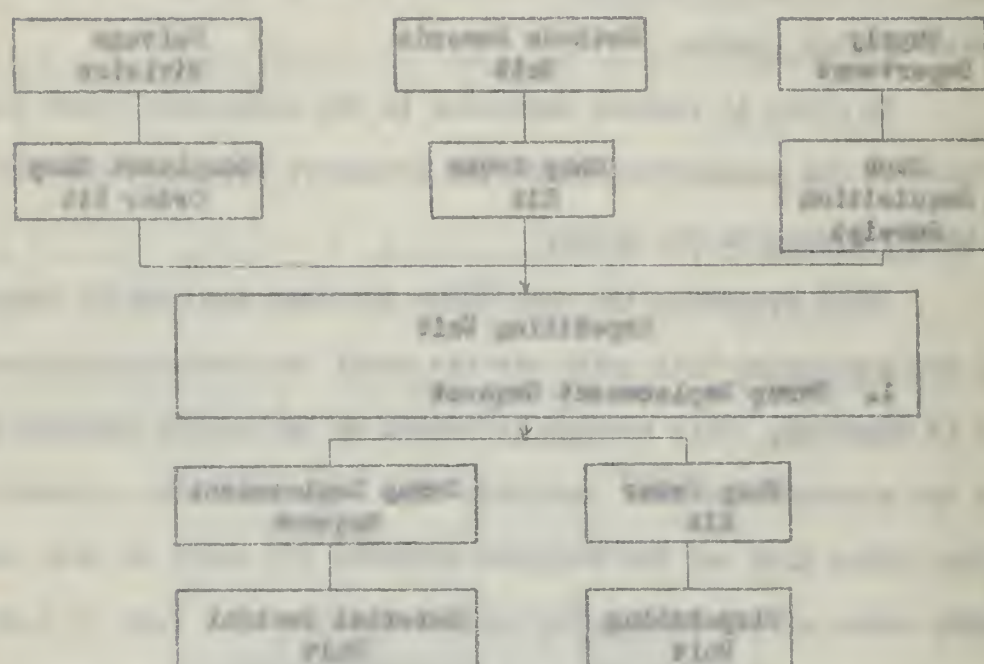
the Master Card, it originates a "scrap replacement request." This form is sent to the Material Control Unit, after which it is handled in the same manner as the original Shop Order Kit.

A general work flow diagram of the Expediting Unit is shown in the chart below.



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 and many of the other things that are done.

A general view of the system of the computer is shown in
 the next page.



The Dispatching Unit

The Dispatching Unit is responsible for the releasing of work to the shop and assembly divisions in accordance with the schedule. The Unit performs "trouble-shooting" activities to coordinate the materials, machine tools, and work for the Production Division. The records charting the progress of the assigned work are kept by the Unit. The material handling problems of the plant are also a responsibility of the Dispatching Unit.

The Shop Order Kit is received from the Expediting Unit, and, with the exception of the Material Requisition Card, the kit is placed in the appropriate pocket board. The pocket boards are arranged by Machining and Assembly Units by months. The Shop Order Kit is taken from the pocket board by the Head of the Unit, who establishes the sequence of work in his unit, based upon the completion date on the Shop Order Kit. To start a new job, the operator obtains the Material Requisition Card from the Dispatching Unit, and draws the required material. The Unit assists in the movement of materials from the storeroom to the workplace. The Unit transfers the partially completed job to the next scheduled Unit, and the Shop Order Kit to the appropriate pocket board of the next scheduled Unit. Thus, the location of the Shop Order Kit in the pocket board serves as a progress record of the job. The high priority Shop Order Kits are designated by a special color code, and these jobs are given special expediting attention.

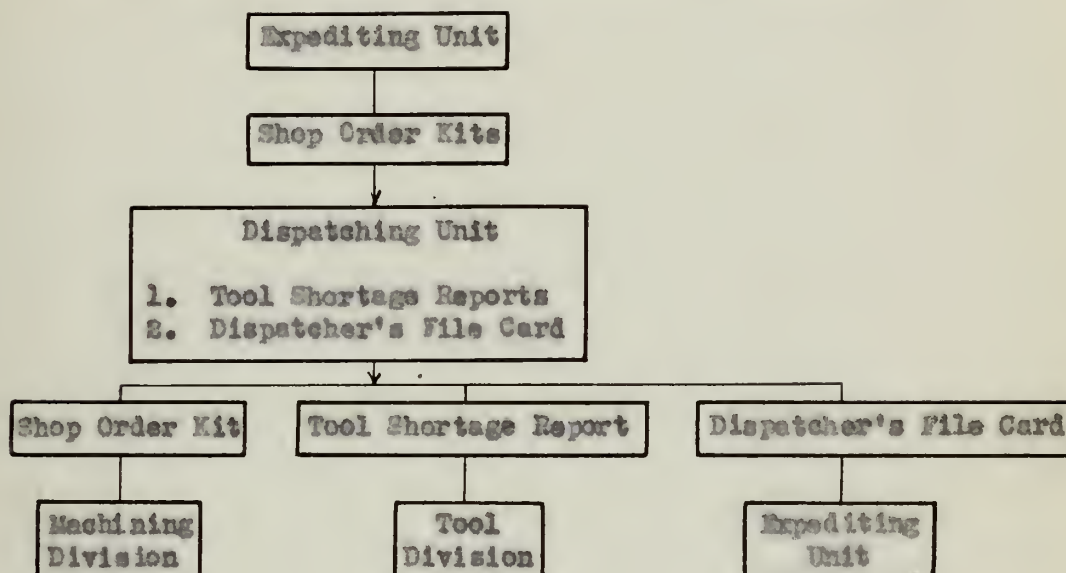
The Dispatcher's File Card, Figure 18, is used to record progress of the shop orders and tool shortages. The Unit makes a daily floor check, gathering the data on the operations on the jobs in process. This data is recorded on the Dispatcher's File Card.

The Inspector in Charge is responsible for the collection of data on the day and weekly basis in accordance with the schedule. The data is then collated and analyzed by the Inspector in Charge and the results are reported to the Director. The Inspector in Charge is also responsible for the maintenance of the records of the day and weekly basis in accordance with the schedule. The Inspector in Charge is also responsible for the maintenance of the records of the day and weekly basis in accordance with the schedule.

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The Tool Shortage Report, Figure 19, is a report to the Tool Division, listing the jobs being held up because of a lack of tools. This report is submitted weekly, and its information is derived from the data gathered on the daily floor checks.

The flow of information into, the originated forms, and the forms departing from the Unit are shown in the diagram below.



The first of these reports, dated 1941, is a report on the trial of the German war criminal, Albert Kriebitzsch, who was executed in 1941. This report is submitted weekly, and the information is derived from the data gathered on the daily floor session.

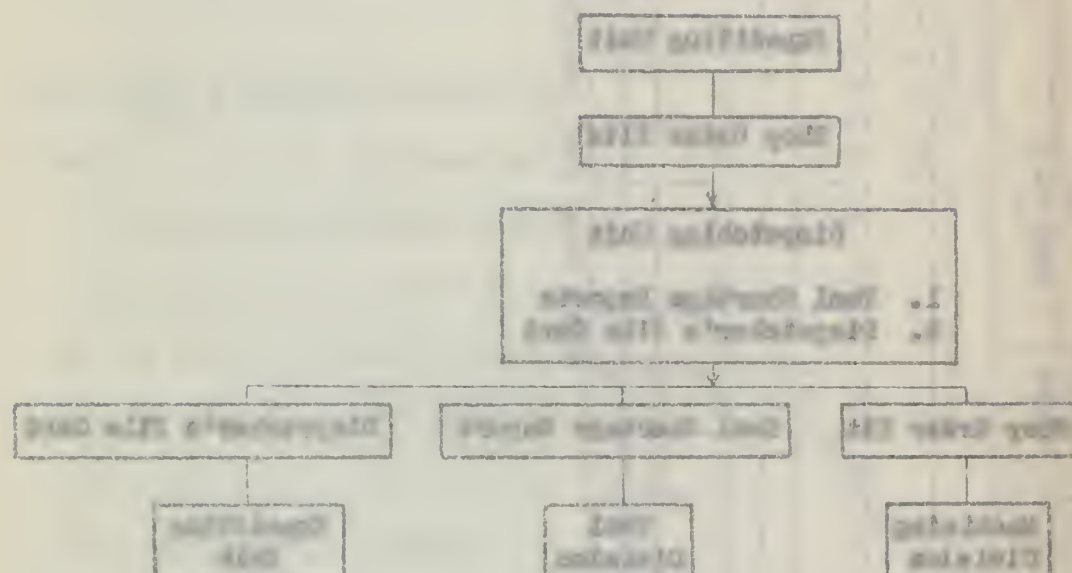


Fig. 19 Tool Shortage Report

LISTED BY THE

[illegible]

cc: H. Evans
R. Kurtz
W. Eaton
A. McQuistan
Disp. File

五

Name		Address		City		State		Zip	
1	John Doe	123 Main St	Anytown	CA	90210				
2	Jane Smith	456 Elm St	Springfield	IL	62701				
3	Robert Brown	789 Oak St	Chicago	IL	60601				
4	Mary White	101 Pine St	Los Angeles	CA	90001				
5	James Green	202 Cedar St	New York	NY	10001				
6	Patricia Black	303 Birch St	Houston	TX	77001				
7	William Gray	404 Walnut St	Phoenix	AZ	85001				
8	Linda Hall	505 Maple St	San Antonio	TX	78101				
9	Richard King	606 Elm St	San Diego	CA	92101				
10	Susan Lee	707 Oak St	Portland	OR	97201				
11	David Miller	808 Pine St	Seattle	WA	98101				
12	Karen Wilson	909 Cedar St	Denver	CO	80201				
13	Michael Taylor	1010 Birch St	San Jose	CA	95101				
14	Elizabeth Anderson	1111 Walnut St	San Francisco	CA	94101				
15	Christopher Moore	1212 Maple St	San Francisco	CA	94101				
16	Michelle Roberts	1313 Elm St	San Francisco	CA	94101				
17	Gregory Scott	1414 Oak St	San Francisco	CA	94101				
18	Deborah Adams	1515 Pine St	San Francisco	CA	94101				
19	Anthony Baker	1616 Cedar St	San Francisco	CA	94101				
20	Kimberly Evans	1717 Birch St	San Francisco	CA	94101				
21	Steven Harris	1818 Walnut St	San Francisco	CA	94101				
22	Angela Clark	1919 Maple St	San Francisco	CA	94101				
23	Benjamin Lewis	2020 Elm St	San Francisco	CA	94101				
24	Christina Walker	2121 Oak St	San Francisco	CA	94101				
25	Jonathan Young	2222 Pine St	San Francisco	CA	94101				
26	Stephanie King	2323 Cedar St	San Francisco	CA	94101				
27	Timothy Hall	2424 Birch St	San Francisco	CA	94101				
28	Rebecca Miller	2525 Walnut St	San Francisco	CA	94101				
29	Kevin Davis	2626 Maple St	San Francisco	CA	94101				
30	Lauren Wilson	2727 Elm St	San Francisco	CA	94101				
31	Brandon Moore	2828 Oak St	San Francisco	CA	94101				
32	Brittany Taylor	2929 Pine St	San Francisco	CA	94101				
33	Justin Anderson	3030 Cedar St	San Francisco	CA	94101				
34	Amber Scott	3131 Birch St	San Francisco	CA	94101				
35	Eric Roberts	3232 Walnut St	San Francisco	CA	94101				
36	Vanessa King	3333 Maple St	San Francisco	CA	94101				
37	Adam Hall	3434 Elm St	San Francisco	CA	94101				
38	Heather Miller	3535 Oak St	San Francisco	CA	94101				
39	Christopher Lee	3636 Pine St	San Francisco	CA	94101				
40	Stephanie King	3737 Cedar St	San Francisco	CA	94101				
41	Jonathan Hall	3838 Birch St	San Francisco	CA	94101				
42	Rebecca Miller	3939 Walnut St	San Francisco	CA	94101				
43	Kevin Davis	4040 Maple St	San Francisco	CA	94101				
44	Lauren Wilson	4141 Elm St	San Francisco	CA	94101				
45	Brandon Moore	4242 Oak St	San Francisco	CA	94101				
46	Brittany Taylor	4343 Pine St	San Francisco	CA	94101				
47	Justin Anderson	4444 Cedar St	San Francisco	CA	94101				
48	Amber Scott	4545 Birch St	San Francisco	CA	94101				
49	Eric Roberts	4646 Walnut St	San Francisco	CA	94101				
50	Vanessa King	4747 Maple St	San Francisco	CA	94101				

The Cost Control Unit

The Cost Control Unit records the commitment and expenditure of funds for the various productive projects, and analyzes estimates and expenditures to aid in locating discrepancies. The overhead budget for the Industrial Department is prepared by the Cost Control Unit.

The Job Order Cost Control Record, Figure 30, is maintained by the Unit, information being transferred to this record from the Stub Requisition, Purchase Orders, Public Vouchers, and Closed Shop Order Tabulations. This record is an accumulative financial sheet giving the amount of funds available, the amount expended to date, and the amount remaining for the job. Also shown is the variance between the estimated and the actual cost of each job order, as well as the accumulated variance.

The Request for Revision of Job Order Estimates is in the form of a letter, used to request additional funds for a job order when it is apparent from the Job Order Cost Control Record that the allotted funds are not sufficient. This request is sent through the Head of the Production Control Division to the plant's administration.

Also in the form of a letter, the Shop Order Report is submitted to the Cost Estimating Unit and the Machining Division, showing the variation between the estimated and actual labor hours of the shop order. This report presents variance data to be investigated by the Cost Estimating Unit and the Machining Division. Information contained in the Shop Order Report is taken from the Job Order Cost Control Record.

The Request for Station Maintenance Funds for the Industrial Department, Figure 31, is made up by the Unit from information contained in the Department Budget Report, the Leave Analysis Report, and the Tabu-

and the actual cost of such for which, as well as the estimated
remains for the job. This shows in the various items the estimated
amount of funds available, the amount expended to date, and the amount
liberated. This item is an accumulative financial record of the
various, business, public, domestic, and other items under
by the Unit, information being furnished in this report from the Unit
The job order book control system, there is, is maintained
for the financial purposes is prepared by the Unit Control Unit.
and expenditures as it is leading statements. The various units
of funds for the various productive purposes, and various activities
The Unit Control Unit records the various items and expenditures

The Bureau for Relief and Rehabilitation is in the process of a reorganization. It is being reorganized to be more efficient and to be able to handle the work of the Bureau more effectively. The Bureau is being reorganized to be more efficient and to be able to handle the work of the Bureau more effectively. The Bureau is being reorganized to be more efficient and to be able to handle the work of the Bureau more effectively.



Fig. 1. The patient's condition at the time of admission to the hospital. The patient was a 45-year-old male, who had been suffering from a chronic illness for several years. The patient was admitted to the hospital on 10/10/1910. The patient was found to have a large, hard, nodular mass in the right breast, which was about 5 cm in diameter. The mass was located in the upper outer quadrant of the breast. The patient had no other symptoms at the time of admission.

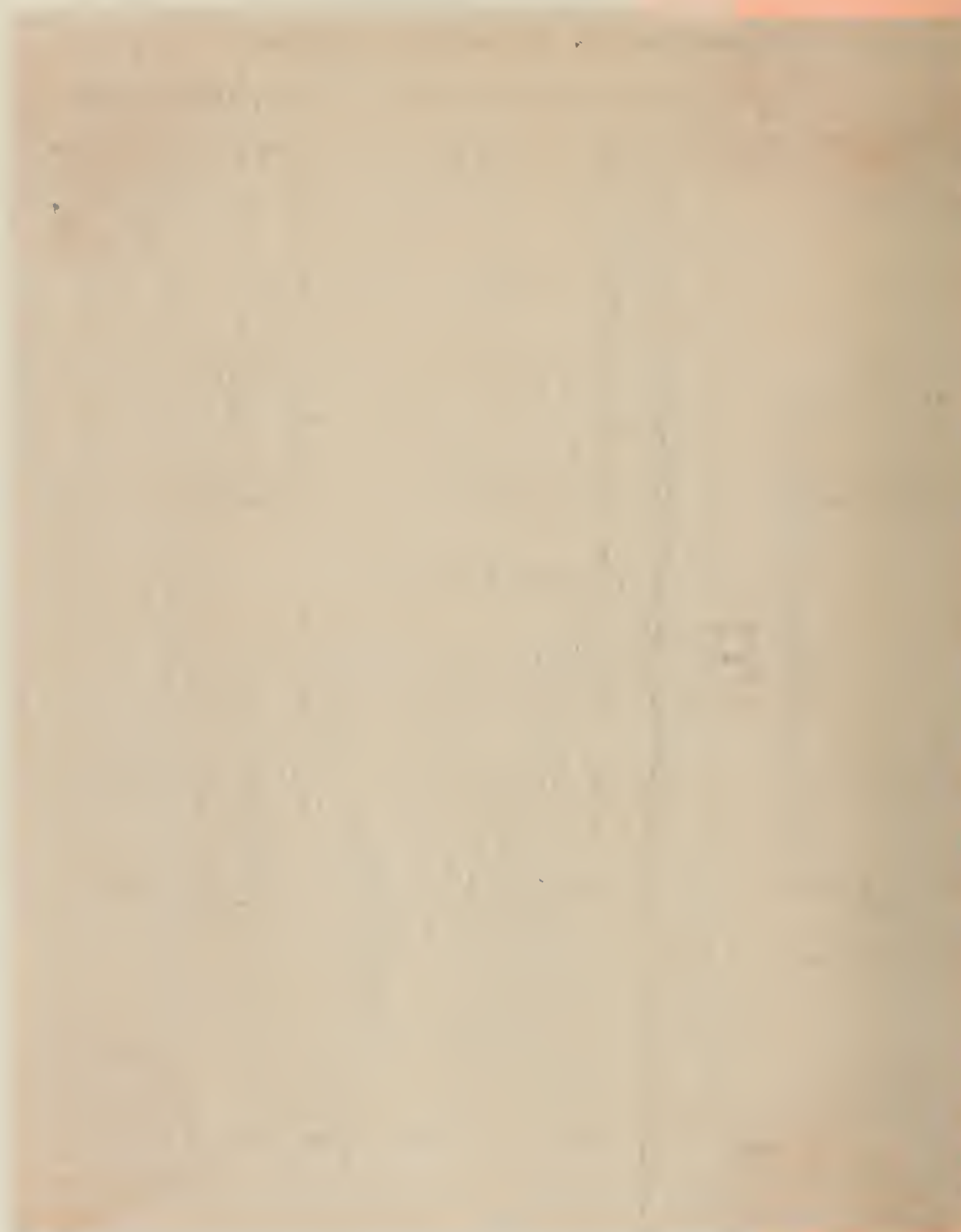
REQUEST FOR STATION MAINTENANCE FUNDS

DEPARTMENT _____ MONTH OF _____		IVB	PER DIEM	TOTAL
1. No. of persons used in computation				
A. Non-productive personnel				
B. Productive personnel				
2. Number of work days in month				
3. Number of holidays in month				
4. Current average daily wage rate				
<u>ESTIMATED COSTS</u>				
5. Non-productive personnel wages				
6. " " overtime				
7. " " terminal leave				
8. TOTAL COST NON-PRODUCTIVE PERSONNEL				
9. Productive personnel Annual and Sick Leave				
A. (Based on ____% of productive personnel pay)				
10. Productive personnel holiday pay				
11. " " terminal leave pay				
12. TOTAL COST PRODUCTIVE PERSONNEL				
13. Miscellaneous labor costs				
14. TOTAL MISCELLANEOUS LABOR COST				
15. TOTAL ESTIMATED LABOR COST				
16. ESTIMATED MATERIAL COST				
17. GRAND TOTAL OF REQUEST				

REMARKS: _____

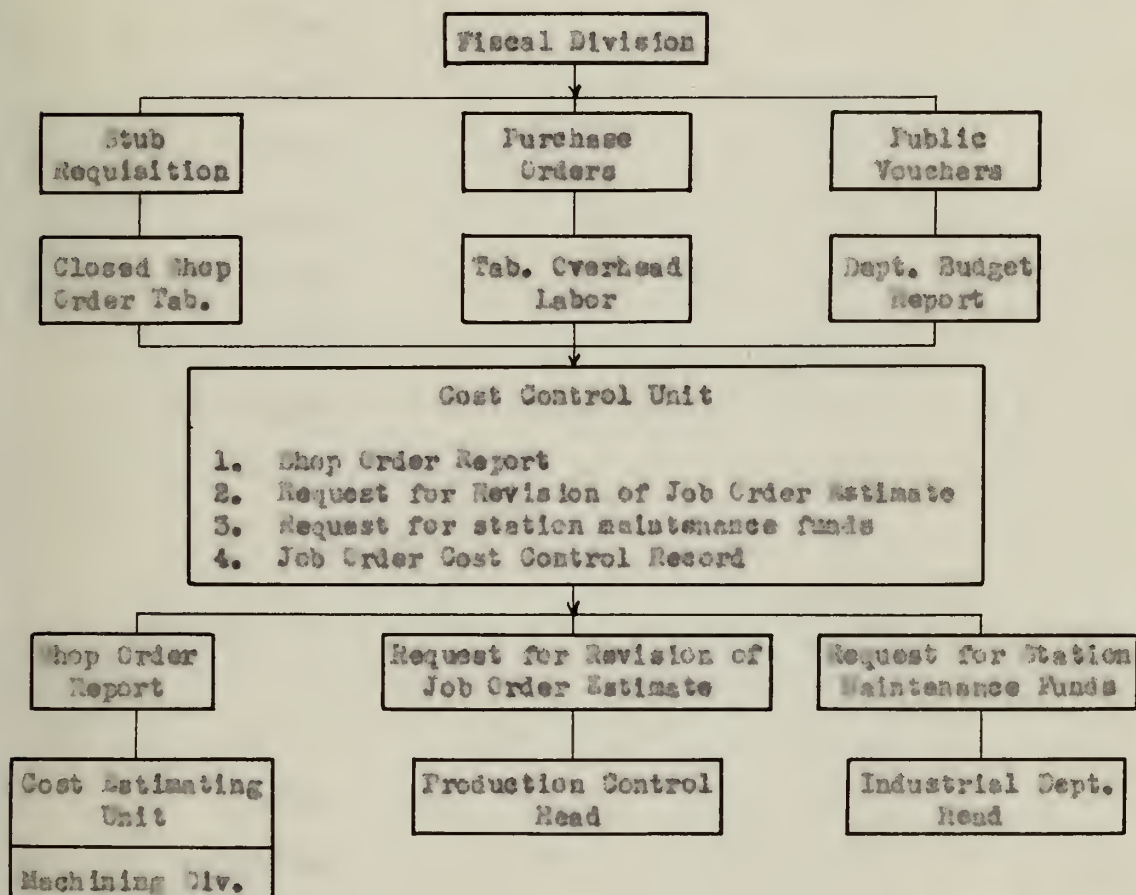
Department Head _____

Fig. 21 Request for Station Maintenance Funds

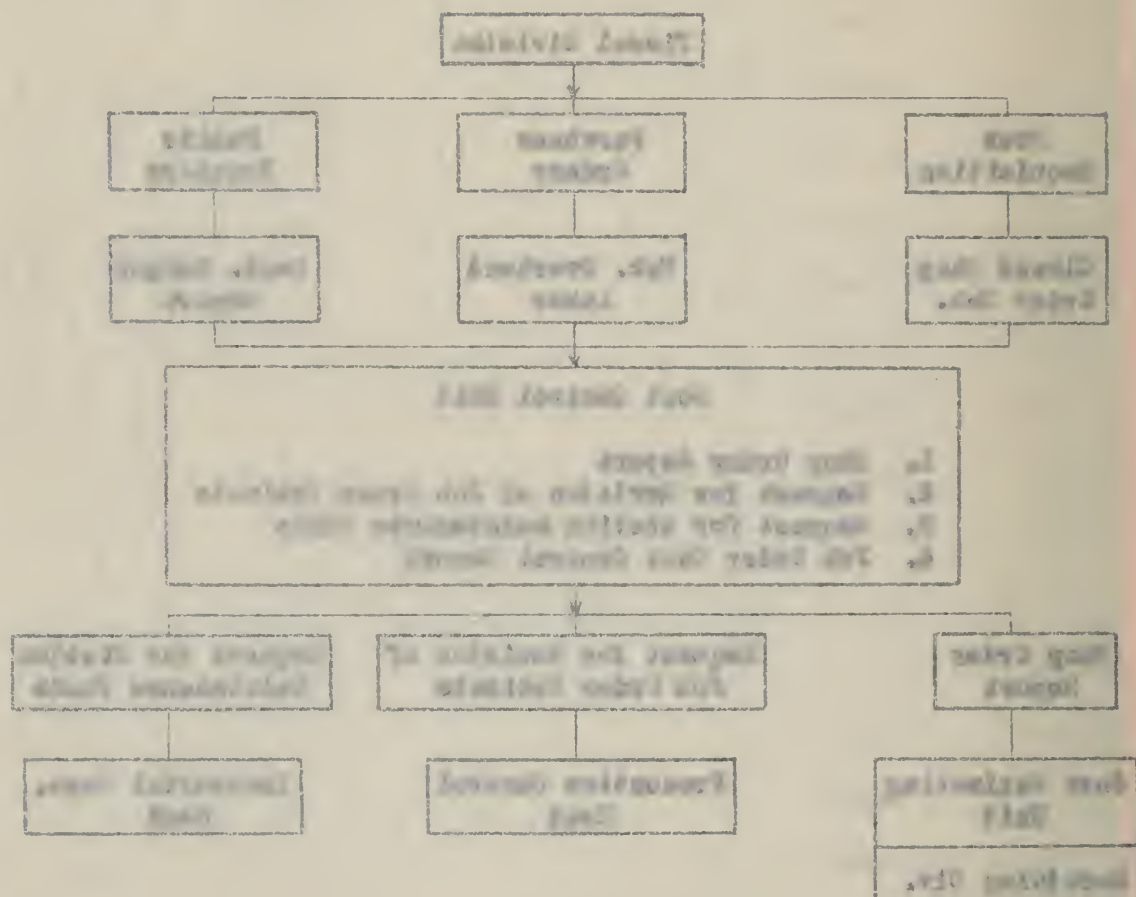


lation Overhead Labor Report. This request consists of estimates of the required overhead funds for the Industrial Department.

The following diagram shows the flow of information into the Unit, the material originated therein, and the next destination of that material.



The Ministry of Finance, which is the main authority for the control of the money supply, has the responsibility for the control of the money supply. This is done by the Ministry of Finance, which is the main authority for the control of the money supply. This is done by the Ministry of Finance, which is the main authority for the control of the money supply.



The Production Stores Unit

The Production Stores Unit composed of the Finished Parts Stores, Semi-finished Parts Stores, and Raw Material and Casting Stores is charged with the responsibility of receiving, storing, and issuing all production material in process of manufacturing. This material includes raw stock, purchased parts, and manufactured parts, either semi-finished or finished.

Purchased parts or raw material coming into the Unit from the Supply Department are accompanied by a copy of a Stub Requisition. Material or parts manufactured in the plant are accompanied by the Yellow Shop Order Master Card from the Shop Order Kit. All incoming material or parts are identified as to the project number to which they apply, the part number, the Stub number or Shop Order number, depending on how received, and the quantity received. The material or parts are then stored in the area allocated for that particular project or as dictated by the form of the material (such as raw material in big sheets). Information is taken from the Stub Requisition and the Shop Order Master Card to record the location of the material on the Finished Parts Locator Record, Figure 22, and to act as additional information for the cross-reference file. This information is also used to make the appropriate entries on the Commitment and Stores Record Cards, Figure 23. This record acts as the balance of stores ledger used in a large number of business concerns. The cross-reference file spoken of is maintained in order to facilitate the shifting of material or parts from one project to another when applicable. However, such shifting must be cleared by the Expediting Unit prior to the shift. The Finished Parts Locator Record, mentioned above, is used as a means of quickly locating any part

[illegible]

Am 1. April 1975 war das Wetter schön.

[illegible]

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*Let me be reminded and made not to forget that you are in London

— 200 —

the first night we were the first to see the stars.

the individual is not a member of the group, and the group is not a member of the individual.

Subject matter must be within the domain of the field.

bioRxiv preprint doi: <https://doi.org/10.1101/2017.06.01.148401>; this version posted June 1, 2017. The copyright holder for this preprint (which was not certified by peer review) is the author/funder, who has granted bioRxiv a license to display the preprint in perpetuity. It is made available under aCC-BY-NC-ND 4.0 International license.

009 The above-mentioned title. This information is also used by other sites.

gaining approval of the House and Senate. The bill was passed by the House on July 1, 1964, and by the Senate on July 1, 1964.

Downloaded At: 11:53 11 September 2009

It is evident that the results of the study are not statistically significant.

[illegible]

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stored in the Unit.

The majority of the issuing of parts and material is done on authority of the green Shop Order Master Card and the transaction is conducted in the reverse order as explained for incoming parts or material.

The majority of the members of the committee are of the opinion that the committee should be authorized to investigate the various matters which have been referred to it, and to report thereon to the committee at the next meeting.

AN EVALUATION OF THE PRODUCTION CONTROL PROGRAM AT THE NAVAL AIRCRAFT PLANT BIRMINGHAM

Definition of Production Control

Production Control may be defined as "the mental and physical techniques and procedures employed to the end that the right quantity and quality of a product shall be produced at the right time by the best and cheapest methods."²

Criteria for Evaluation

There is a wide diversity of opinion in the literature on production control as to the functions which should be included in a production control procedure. The functions listed below represent some of those appearing in most of the texts of the Bibliography.

1. The preparation and issuance of production orders and forms such as work orders, time cards, move orders, materials issue slips, tool issue slips, etc.
2. Purchase requisitioning to obtain raw materials and special items bought outside
3. Preparation of route sheets
4. Work scheduling
5. Plant loading
6. Work dispatching
7. Determination of the labor requirements
8. Maintenance of production records
9. Expediting of manufactured and purchased items
10. Analysis of idle machine time

² Bethel, Lawrence L.; Tamm, Walter L.; Steuter, Franklin S.; King, Edward L., Production Control, McGraw-Hill Book Company, Incorporated, 1948, pp. 2.

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1. General description of the system
2. Description of the components
3. Description of the interactions
4. Description of the results
5. Description of the conclusions
6. Description of the limitations
7. Description of the future work
8. Description of the acknowledgments
9. Description of the references
10. Description of the appendices

Discussion

It is understood that not every production control procedure will include all of these functions, and that some procedures may include others not listed here. For the purpose of this evaluation, an analysis of the production control procedure at BOMI has been conducted to determine how the functions listed above are accomplished; whether or not improved means of accomplishing the functions can be recommended; and if the functions are not accomplished, whether or not it is deemed advisable to perform the functions.

The Preparation and Issuance of Production Orders and Forms. The function of preparing and issuing production orders and forms is shared by most if not all of the units of the Production Control Division at the plant. The several units prepare and issue the orders and forms that are applicable to their primary functions. The units and the forms they originate and issue are very briefly described below:

1. Material Control Unit originates and issues the following:
 - A. The Stub Requisition, used to requisition raw materials and purchased parts
 - B. The Firm Requirement and Obligation of Material Form, used as a means of screening the supply system for parts needed on a project
 - C. The Production Breakdown Sheet, establishing the quantity of a component part to be manufactured
2. Project Scheduling Unit originates and issues the following:
 - A. The Internal Schedule, establishing the completion date of each project
 - B. The Forecast of Productive Labor, establishing the over-all

It is suggested that the following items be included in the report of the Commission, and that the Commission be authorized to conduct such studies as may be required for the purpose of this resolution. The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted.

The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted. The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted.

1. The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted.
2. The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted.
3. The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted.
4. The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted.
5. The Commission is requested to submit a report to the General Assembly at its next session on the progress made in the implementation of the resolution and on the results of the studies conducted.

production schedule of the plant

- C. The Man Load and Performance Chart, an efficiency standard for the shop, showing the amount of work completed by the shop against the amount of work released to the shop
 - D. The Monthly Man Load Summary, a report including the utilization of man-hours for the past month, recommended inter-divisional transfers of personnel, and status of current projects
3. The Shop Scheduling Unit originates and issues the following:
- A. The Shop Order Kit, the authority upon which the shop starts, processes, and completes a job
 - B. The Weekly Machine Load Report, indicating the amount of work released to, completed by, and currently available to the shop
 - C. The Assembly Monthly Schedule, a monthly schedule indicating priority on projects to be assembled
4. The Dispatching Unit originates and issues the following:
- A. The Dispatcher's File Card, used to record tool shortages and the progress of the shop orders
 - B. The Tool Shortage Report, used to indicate what jobs are being held up because of the lack of tools
5. The Expediting Unit originates and issues the following:
- A. The Scrap Replacement Request, used to originate the work necessary to replace parts that have been rejected or scrapped

The function of preparing and issuing production orders and forms is accomplished at the plant in such a manner as to aid and facili-

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the fact that the *in vitro* and *in vivo* results are in good agreement.

With all of his life's time to devote to his family, he was able to do so.

16. The specific use of the word "and" in the title is significant.

Added to the list of the following:

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(continued)

On the map showing the boundaries of the various states, the following states are shown:

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doi:10.1017/S002229240000209 Printed in the United Kingdom

To provide our children, through our religious education,

at different intervals for the first 10 days, and then at 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, and 100 days after the start of the experiment.

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A. The primary purpose of the study is to determine the effect of the proposed changes on the company's financial performance.

Journal of Management Inquiry 16(4)

4. The following left columns will form the right-hand

1. The algorithm's *split* call, line 10, uses the *split* function

questo può, alla lunga, essere utile.

3. The first derivative of the function $f(x)$ is given by $f'(x) = 2x + 3$. Find the function $f(x)$ if $f(0) = 5$.

about 75 miles out to sea, and the vessel was

6. The following table shows the results of the regression analysis:

4. The long-run equilibrium interest rate is influenced by the

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2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2813 2814 2815 2816 2817 2818 2819 2820

The Journal of the American Academy of Religion

There is no significant difference in the mean age of the subjects in the two groups.

tate the service rendered the production divisions. The present distribution of the responsibility for preparing and issuing the orders and forms is the result of various changes in the system through continuous investigations seeking improvement.

Purchase Requisitioning. The function of originating and issuing purchase requisitions to obtain raw materials and purchased items is accomplished by the Material Control Unit in the form of a Stub Requisition. The Unit receives the Parts list, the Prints, and the Cost Estimating and Scheduling Form. From this information, the Unit issues the Production Breakdown Sheet which establishes the quantity of the various component parts. This established quantity includes the Unit's estimation for scrap and losses. Using the Production Breakdown Sheet as a guide, the Unit investigates the Supply catalogues to ascertain whether the required material is listed as a stock item. If the required material appears in the catalogue, the items are listed on the Firm Requirement and Obligation of Material Form, originated by the Unit and sent to the Supply Department. The Supply Department processes these items to determine the availability, location, cost, and estimated delivery date of the materials. This information is recorded on the Firm Requirement and Obligation of Material Form which is then returned to the Material Control Unit.

Upon receipt of this form and if the Supply Department has indicated that it is able to furnish the required materials by the date desired, the Unit requisitions the materials from the Supply Department by Stub Requisition. If the Supply Department is unable to furnish the required materials from the available supplies, the Unit issues a Stub Requisition authorizing the purchase of the required materials from a

...the service rendered the question arises. The question arises...

[illegible]

Under category of this type and in the supply department has indicated that it is going to furnish the required quantities by the date desired. The Unit requested the materials from the supply department by that date. It was supply department is usually in position to require materials from its available supplies. The Unit knows a few materials and indicates the purchase of the materials available from a

civilian concern. This Stub Requisition is also sent to the Supply Department, the procurement agency for all materials.

It seems inevitable that government supervision brings with it a time-consuming complex system of material procurement. The very nature of federal direction of a plant necessitates more "red tape" than private industry encounters. The system of material procurement at NOPI, however, reduces the complexities of government regulation to a minimum, and accomplishes the job in the shortest possible time with a maximum of personnel economy. The fact that NOPI employs men well versed in the intricacies of government regulations contributes a great deal to the efficient functioning of purchase requisitioning at the plant.

The Preparation of Route Sheets. The preparation of the route sheet is accomplished by the Shop Scheduling Unit by the issuing of the Shop Order Kit. The Unit receives the Process Routing Sheet and the Production Breakdown Sheet, and maintains a load chart in terms of man-hours for each Machining Unit. The routing of a component part is established by the Unit from information contained in the Process Routing Sheet, which indicates the type of machine that is to perform the operation, and in the load chart giving the load of the Machining Units. Thus, the routing is performed in terms of Machining Units, whose designating numbers are placed on the Shop Order Kit corresponding to the listed operation numbers.

The designation of the specific operator and machine for each operation is accomplished by the Head of a Machining Unit.

The above procedure for the preparation of the route sheet fulfills the needs of the shop at NOPI. The routing is based upon the

[illegible]

man-hour method of loading the shop. This basis is used because the available man-hours of labor is the limiting factor in the plant's productive capacity. The wide dissimilarity of the plant's products makes it necessary for the head of a machining unit to determine individually the specific operator and machine that should perform a certain job. In many cases, the required machining tolerance of a job is such that only a specific operator using a specific machine can accomplish the work. The head of a machining unit, from past experience, is able to assign such operators and machines for a specific job far better than could the Production Control Division were such a detailed routing procedure attempted.

From the point of view of the needs of the shop and minimum overhead expense in accomplishing the preparation of the route sheets, the procedure used at NOFI is excellent.

Work Scheduling. The responsibility of scheduling work is shared by several units in the plant. The Forecast of Productive Labor form is originated by the Project Scheduling Unit, establishing the over-all production schedule of the plant for approximately eighteen months in the future. A new project is coordinated into this over-all schedule by the Unit with a proposed delivery date determined. Using this delivery date as a goal, the Unit then makes up an Internal Schedule on the project. This is passed on to the Shop Scheduling Unit to serve as the basic schedule for the various component parts. The Shop Scheduling Unit determines the completion date required for each component part according to the requirements of sub-assembly schedules, machining time required on sub-assemblies prior to final assembly, etc. This adjusted completion date is placed on each Shop order Kit (one for each

component part). When the Shop Order Kits are received by the Dispatching Unit, they are placed in the pocket board pertaining to the Machining Unit indicated on the Kit as that Unit by which the part is first machined. The Head of each Machining Unit takes the cards from the appropriate pocket board and, after considering the completion dates indicated on the Shop Order Kits, he establishes the sequence in which the jobs will be processed.

The critical factors of a ceiling on personnel and the necessity for loading the plant by man-hours make this the best type of scheduling for the plant's needs. The actual "when" in terms of a certain day or hour on which a part is to be started has to be determined by someone (in this case, the Head of the Machining Unit) who is in direct contact with and has charge of the men in the Machining Units.

The system of scheduling is practiced at the plant is basically similar to the accepted practice in most commercial concerns. It is felt that the scheduling has to be done in this manner to coordinate adequately into the over-all plant schedule all the many dissimilar projects that are allocated to the plant for production.

Plant Loading. The function of plant loading is accomplished by the Project Scheduling Unit and the Shop Scheduling Unit. The plant is loaded in terms of man-hours of labor per month. The Project Scheduling Unit issues the Forecast of Productive Labor, a chart displaying the over-all plant production forecast in terms of man-hours, projected eighteen months ahead. Various new projects are added to the plant's load schedule based upon the required delivery dates of the Bureau of Ordnance. From this load schedule, for each new project, the Project Scheduling Unit processes a Cost Estimation and Scheduling Form which

...and will be ...
...of the ... life, as ... in ...
...the ... and ...
...The ... of ...
...on the ... at first ...
...they are placed in the ... in the ...
...then you may ... by the ...

The original document is a letter from the Secretary of the Navy to the Secretary of the War, dated 1864. The letter discusses the proposed purchase of the ship "Albatross" from the British Navy. The Secretary of the Navy is in favor of the purchase, while the Secretary of the War is opposed. The letter is signed by the Secretary of the Navy, G. B. Davis.

The extent of withdrawal is indicated in the chart in Exhibit 10. The extent of withdrawal is indicated in the chart in Exhibit 10.

The first of these is the fact that the
 Government has not yet decided whether
 it will accept the offer of the
 United States to purchase the
 rights in the patent. The second
 is the fact that the Government
 has not yet decided whether it
 will accept the offer of the
 United States to purchase the
 rights in the patent. The third
 is the fact that the Government
 has not yet decided whether it
 will accept the offer of the
 United States to purchase the
 rights in the patent.

shows the expected monthly delivery rates of the project. Based on these delivery rates, the Unit issues the Internal Schedule which shows the completion dates of the various sub-assemblies.

The Shop Scheduling Unit maintains a load chart in man-hours by Machining Units. From the information contained in the Internal Schedule, the Shop Scheduling Unit loads the Machining Units to capacity.

To record the completion of work for the purposes of adjusting the above loading procedure, the completed Shop Order Kits are returned to the Shop Scheduling Unit which in turn removes the completed work from the load chart. The Unit issues the Weekly Machine Load Report which contains the number of man-hours completed by and the present amount of work available for each Machining Unit. This report is received by the Project Scheduling Unit which makes the proper adjustments to the Internal Schedule, the Cost Estimation and Scheduling Form, and the Forecast of Productive Labor.

Since the function of plant loading is closely integrated with the functions of preparation of route sheets and work scheduling, the procedure of plant loading at NOPI is performed by the same personnel. The system permits great flexibility, a factor necessary in an organization producing equipment subject to continuous change.

Work Dispatching

The function of work dispatching is done by the Dispatching Unit of the Production Control Division. The Shop Order Kit, the authority for all work done in the shop, is received by the Dispatching Unit from the Expediting Unit. The kit has a notation on the master card indicating the month of completion. The Dispatching Unit takes all the cards in the kit and perforates the indicated month of completion on the small

There are several reasons why the project should be
done. First, it is a very important project and it
will be very useful to the community.

The first reason why this project is important
is that it will help to improve the quality of
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calendar across one end of the card. The kit now indicates to anyone who handles any of the cards just when the part is due for completion. The Dispatching Crib contains several pocket boards, arranged by Machining Units and months. The kit, minus the Material Requisition Card, is placed in the appropriate pocket board of the Machining Unit scheduled for the first operation. The Shop Order Kits are taken from the pocket board by the Head of the Machining Unit, who arranges the sequence of the Shop Order Kits, and issues them to the operators. The operator first goes to the Dispatching Unit to obtain the Material Requisition Card in order that he may procure the necessary materials. This gives the Dispatching Unit the commencement date on the Shop Order Kit which is recorded on the Dispatcher's File Card.

The Shop Order Kit consists of various colored IBM cards. As has been indicated above, among these cards is the one for material requisitioning. Also included in the kit is the tool requisition card (the brown card). Three very necessary functions of Dispatching have thus far been accomplished, and they are the release of the work order, the material, and the tool requisitions.

When the operations scheduled for a Machining Unit are completed, the work piece and the Shop Order Kit are returned to the Dispatching Crib. The Shop Order Kit is placed in the pocket board of the next scheduled Machining Unit, and the work piece is stored in the vicinity of the Dispatching Crib. This procedure is repeated until the job is completed, at which time the Shop Order Kit is closed out and the yellow master card returned to the Shop Scheduling Unit.

Approximately eighty-five percent of the work on one component part is accomplished by one Machining Unit; that only about fifteen per-

cent of the work must pass through the Dispatching Crib a second time. In order to prevent the loss of time, additional material handling, and traffic jams in the Dispatching Crib area for this fifteen percent of the work, it is recommended that the material handlers be instructed to transport the work pieces and Shop Order Kits directly to the next scheduled Machining Unit, informing the Dispatching Crib of the move.

The status of the various jobs is indicated by the location of the Shop Order Kit in the various pocket boards, and the information recorded on the Dispatcher's File Card. As mentioned above, during the process of performing the sequence of operations required on a component part by each successive Machining Unit, the Shop Order Kit is progressing to and from the pocket board corresponding to the same Machining Units. This location of the Shop Order Kit in the various pocket boards serves as a rough progress report. The Unit makes a daily floor check of the shop, recording the progress of each job. This information is transferred to the Dispatcher's File Card. Thus, the Unit maintains a current record of the progress of each job.

The functions of Dispatching as practiced at the plant accomplishes the service requirements of the shop. Although this system, as do most involving work dispatching, requires much attention to detail and great care in recording procedure, it assures ease and accuracy in ascertaining the progress of jobs. Other than the suggestion above for the possible elimination of lost time and traffic jams in the Dispatching Crib area, the author rates the NCPI system of work dispatching as adequate and well suited to the needs of the plant.

Determination of the Labor Requirements. The function of determining the labor requirements of the plant is accomplished by the Project

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Scheduling Unit. The Unit recommends both inter-divisional employee transfers and adjustments in the labor force, i.e. the hiring and firing of employees. These recommendations are prepared in the form of a letter, the Monthly Man Load Summary, which is submitted through the Head of the Production Control Division to higher authority for action.

The information from the above letter is taken from the Forecast of Productive Labor chart. By comparing the available man-hours of labor with the requirements as indicated by the chart, the Unit is able to make an accurate estimate of the labor needs of the plant. Since the employees in the Machining and Assembly Divisions are skilled craftsmen, and in many cases, are capable of working in the several Units of the Machining and Assembly Divisions, the Project Scheduling Unit recommends the transfer of personnel between these two Divisions to equalize the estimated work load. When the work load can not be carried by the current staff, the Unit recommends the additions to the staff.

The current trend to include the handling of labor requirements among the functions of the production control division is reflected in the procedure at NCFI. Until recently, this has been the responsibility of the personnel division in most plants, or of the foreman, whose ability to foresee future changed conditions is necessarily limited. The personnel division is aided by the production control division in its job of ascertaining the type of labor to be hired to handle increased production. This system seems to meet adequately the needs of the plant.

A possible improvement in the existing system might be the

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inclusion of a Man Load Chart of labor classifications to facilitate the assigning of the right man to the right job. The basis for this selection is now man-hours; a man is selected for a job without reference to his labor grade. If the degree of his skill were taken into consideration, it might insure a more exact matching of the man and the job.

With the exception of this possible refinement, the author feels that the labor requirements of NCPI are handled well with a maximum of efficiency.

Maintenance of Production Records. The function of the maintenance of production records is accomplished by the Project Scheduling Unit and the Shop Scheduling Unit. The Weekly Machine Load Report, issued by the Shop Scheduling Unit, contains the number of man-hours of work completed by the shop. This report is received by the Project Scheduling Unit and used to construct the Unit's Load and Performance chart. This chart consists of two portions, the performance portion only being discussed here. The performance chart presents four curves: the performance potential in man-hours per week; the monthly average of the performance potential; the work completed in man-hours per week; the monthly average of the work completed. The performance potential curves are based upon the estimation of the Cost Estimating Unit. The work completed curves are recorded times required by the shop to complete the Shop Order Kits. The two weekly curves show a certain amount of fluctuation. The monthly averages are used to display the trend, and serve as an efficiency standard for the shop. When the monthly average of the work completed curve drops below the eighty-five percent value of the monthly average of the performance

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potential curve, the situation is investigated by the Heads of the Production Control Division and the Machining Division.

WPII's system of maintaining production records makes shop performance readily apparent. Its weekly check is of sufficient frequency and thoroughness to assure an accurate account of work progress. Were reports made in more detail or required more often, a superfluity of records would exist, and an unnecessary strain placed on personnel effort in handling them. The system of maintaining production records as employed no doubt aids considerably the smooth and efficient operation of the plant.

Expediting of Manufactured and Purchased Items. The function of expediting manufactured and purchased items is accomplished by the Expediting Unit. To prevent a Shop Order Kit from reaching the shop prior to the time the required materials are available, the Expediting Unit ascertains that the materials are physically located in the plant before releasing the Shop Order Kit to the shop. Thus, the Unit receives the Shop Order Kit from the Methods Records Unit, and the Sub Requisition Receipt from the Supply Department. This latter form denotes the arrival of the required material at the plant. The Unit makes a weekly check of all kits being held up because of a lack of materials, and makes a bi-monthly report of such held-up kits to the Head of the Production Control Division.

An important feature of the expediting function at the plant is the manner in which the Unit handles the substitute materials. There are two general types of substitution of materials; one is a change in the type and chemical composition of the original material, and the other is a substitution of the same material allotted to dif-

As pointed out above, the results of the study are not only of interest to the general public, but also to the scientific community. The study is a good example of the use of the scientific method in the study of human behavior. The study is a good example of the use of the scientific method in the study of human behavior. The study is a good example of the use of the scientific method in the study of human behavior.

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ferent projects. The former substitution of material requires the approval of the Methods Section or the Engineering Department. The Expediting Unit follows through on this type of change by securing the approval for the substitution from the proper group. To accomplish the second type of substitution of material, that of using the same material which has been allotted to a different project, the Expediting Unit maintains a record of all Shop Order Kits and the required materials for each. If two Shop Order Kits use the same materials, and the available material has been allotted to one Shop Order Kit whose use is being delayed pending the arrival of other component parts, the Expediting Unit authorizes the necessary change in the allotment of the material to permit the manufacture of at least one part.

Since the ability to adapt to continuous changes is among the primary requisites of a plant such as NOPI, the flexibility of the plant's existing expediting system lends itself well to the plant's needs. A more rigid system would hamper the smooth and efficient flow of the manufactured and purchased items into the mainstream of work. In addition, the "red tape", which NOPI's flexibility of system has successfully reduced to a minimum, would cause a tie-up in the work flow; possibly necessitate an increased number of employees to handle "snarling"; and, consequently, add to the plant's personnel expenses. Increased expenditure is one of the things most diligently avoided at NOPI; efficient and speedy delivery of the product is one of the plant's chief goals. Since the expediting system at the plant prevents the former and effects the latter, it is the appraisal of this author that NOPI's present system is excellent.

1. The Commission has been informed that the Government of the United States has been requested to provide information regarding the activities of the Communist Party in the United States. The Commission has been requested to provide information regarding the activities of the Communist Party in the United States.

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Analysis of Idle Machine Time. The function of analyzing idle machine time is not accomplished at the plant. When the plant was converted to Navy operation in 1945, the basic plans were to design flexibility into the productive capacity of the plant. For this purpose, three machines per employee were installed in the shops. Due to the ever increasing demands upon the plant, the present ratio has dropped to two machines per employee. The plant, however, continues to possess an excess of machine tools in relation to the employees. Thus, an analysis of idle machine time would prove of no use to the plant.

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CONCLUSIONS

This investigation has resulted in the conclusion that the production control procedure practiced at the Naval Ordnance Plant, Indianapolis, Indiana, embodies and employs all of the current basic production control principles required to meet the particular needs of such a plant. The procedure is flexible enough to assimilate and directed by individuals capable of seeing the need for the incorporation of current trends where applicable; that is, such as the assumption of the responsibility by the Production Control Division for the determination of the labor requirements. The ability of the plant to adapt its manufacturing processes to so many dissimilar items of production is the outstanding manifestation of the efficiency of the present production control procedure.

The investigation of the production control procedure at NOLI has the possible desirability for the following minor recommended changes:

1. To prevent loss of time, unnecessary material handling, and heavy traffic in the vicinity of the Dispatching Crib area, it is recommended that the material handlers be instructed to transport the work pieces and Shop Order Kits directly to the next scheduled Machining Unit instead of having these items returned to the Dispatching Crib at the completion of each Machining Unit's work on that part.
2. It is recommended that further study be conducted concerning the desirability of a Man Load Chart of labor classifications

to facilitate the forecasting of labor requirements by the Project Scheduling Unit and would consist of a more detailed breakdown of the columns of the Weekly Machine Load Report.

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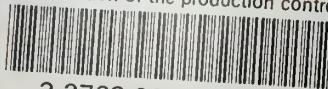
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